Heating Piping & Air Conditioning

OCTOBER 1959

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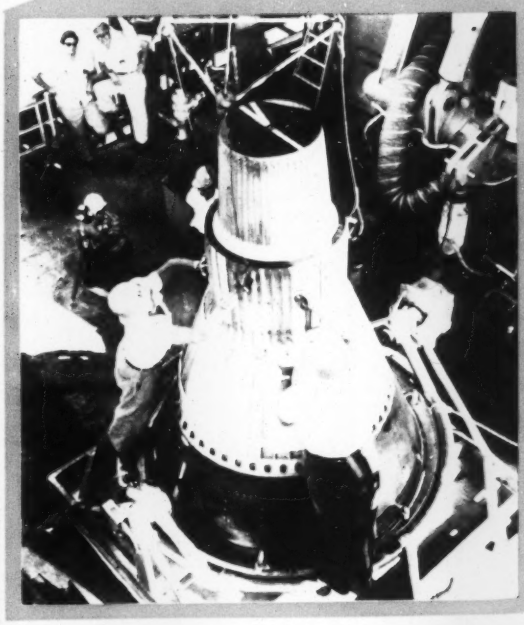

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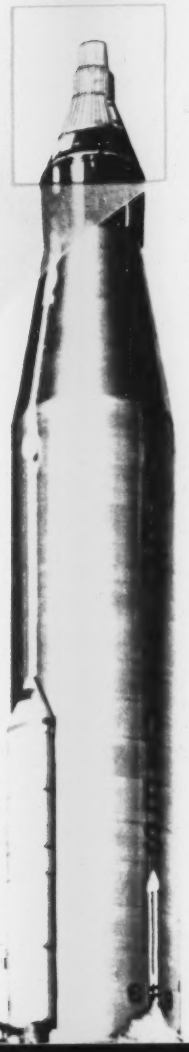

Preparing for the count-down, "Big Joe" capsule is hoisted and secured atop its Atlas ICBM booster. This is a prototype of future space vehicles in which environment control will play a vital role

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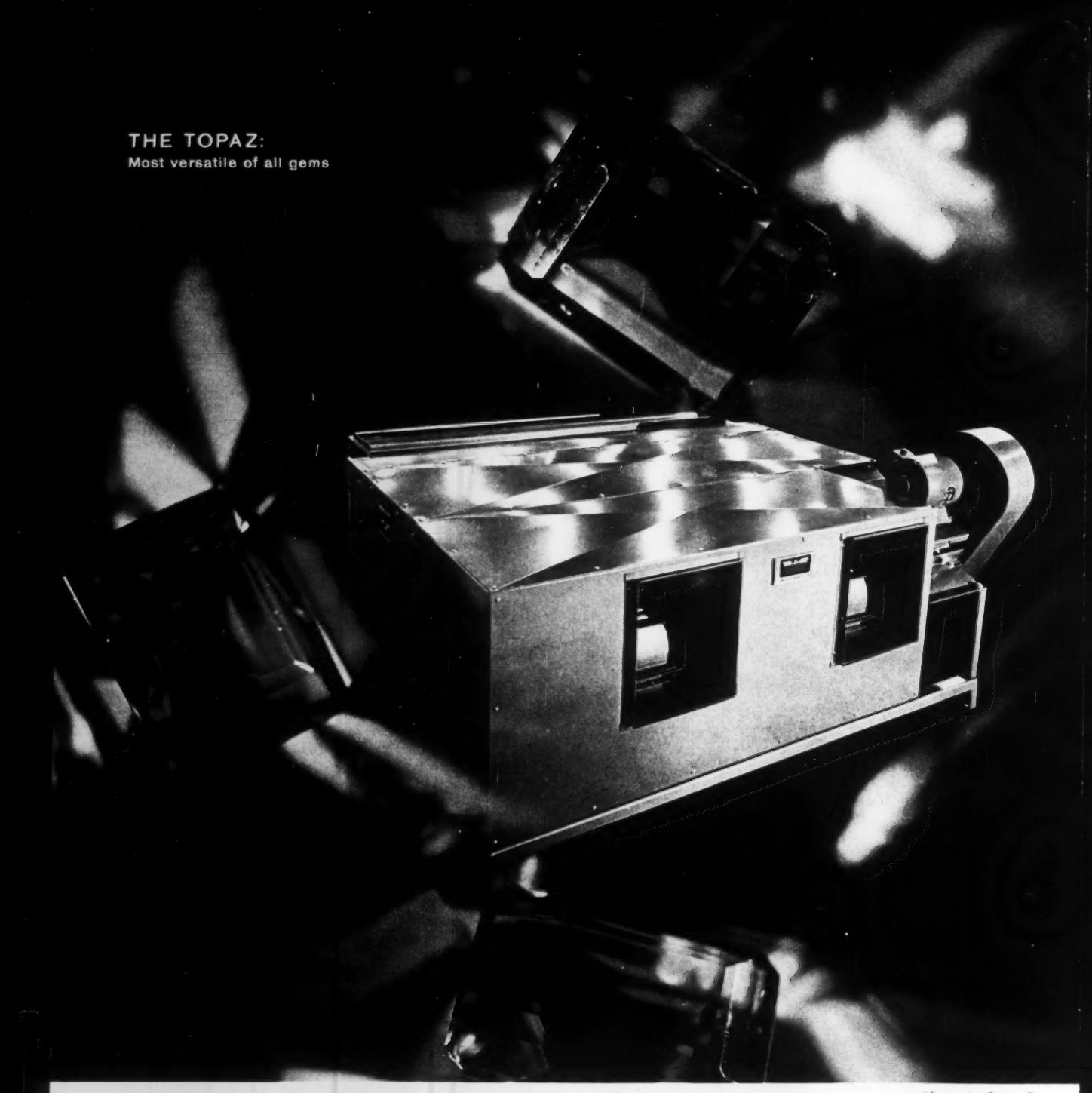
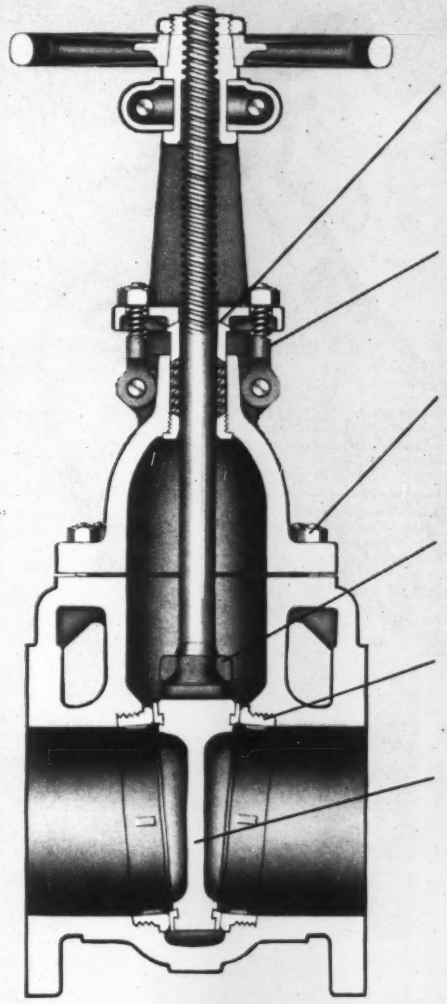


"Topaz by Cartier"

EXCITING THINGS ARE HAPPENING IN WORTHINGTON AIR HANDLING EQUIPMENT

Try as hard as you like you can't dream up an installation—standard or multi-zone, vertical or horizontal—where Worthington air handling equipment won't fit. The fan section may be mounted with front, top or bottom discharge. Install them as you wish, where you wish—saving valuable space, time and installation costs. Any wonder we call them jewels of great value. Worthington Corporation, Ampere Station, East Orange, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ont.

WORTHINGTON



Two-piece ball-type gland prevents binding on stem even when gland bolt nuts are pulled up unevenly.

Swinging gland eye bolts allow free access for repacking . . . can't get lost.

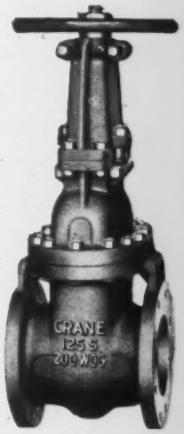
Greater number of bonnet bolts to give more uniform gasket loading; tighter bonnet joint.

T-head disc-stem connection— pressure on disc can't bend valve stem.

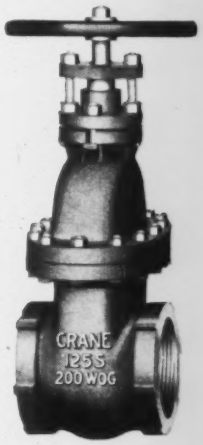
Body seat rings —shoulder type—are screwed in and locked; can't loosen in service.

Long disc guides minimize drag on seating surfaces . . . prolong valve life.

No. 465½. 6" gate valve



No. 465½. 125-Pound, OS&Y, bronze trimmed. Flanged ends. 2" to 48". Also in all-iron.



No. 460. 125-Pound, non-rising stem. Bronze trimmed; screwed ends. 2" to 8". Also in all-iron (to 4" only).

The valves most plants rely on—
CRANE 125-POUND IRON BODY GATES

On general utility services . . . water mains and distribution lines . . . low-pressure steam and hot water . . . air and gas . . . more plants rely on Crane No. 465½ iron body bronze trimmed gates than on any other valve in this class. The cross section above reveals some of the advantages of Crane improved iron valve design . . . how they assure dependable operation through long life and provide for convenient servicing.

To enable you to standardize on these economical, efficient valves, Crane builds No. 465½ gates in sizes from 2 to 48 in. Popular sizes are available from local stocks of your Crane branch or Crane wholesaler.

See your Crane catalog for the widest selection of iron body valves: gates, globes, angles and checks. Your local Crane Representative will be glad to help choose the right valves for your service.

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Exclusive Sales Agent to Air Conditioning and Refrigeration Wholesalers
ANSUL CHEMICAL COMPANY, Marinette, Wisconsin

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Heating Piping & Air Conditioning

Vol. 31, No. 10 — October 1959

(With which is merged the Aerologist)

for CONSULTING ENGINEERS, MECHANICAL (heating, piping, and air conditioning) CONTRACTORS, and ENGINEERS WITH PLANTS AND BIG BUILDINGS

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Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8744 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

801ST

How Different Condensing Rates Can Slow Production

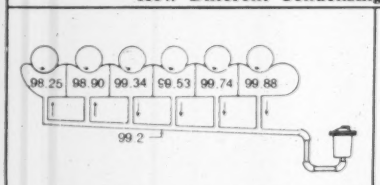

Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

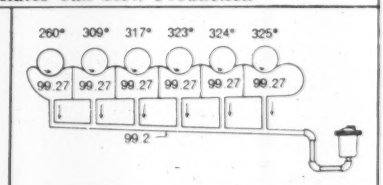

Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

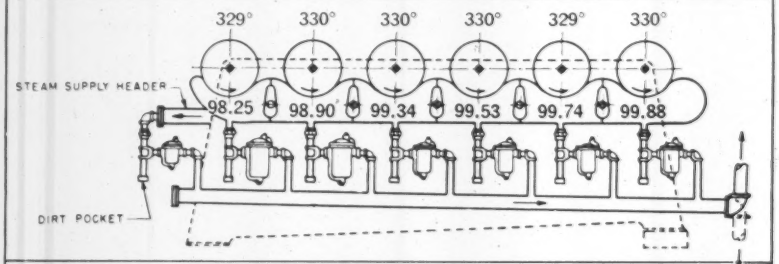

Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

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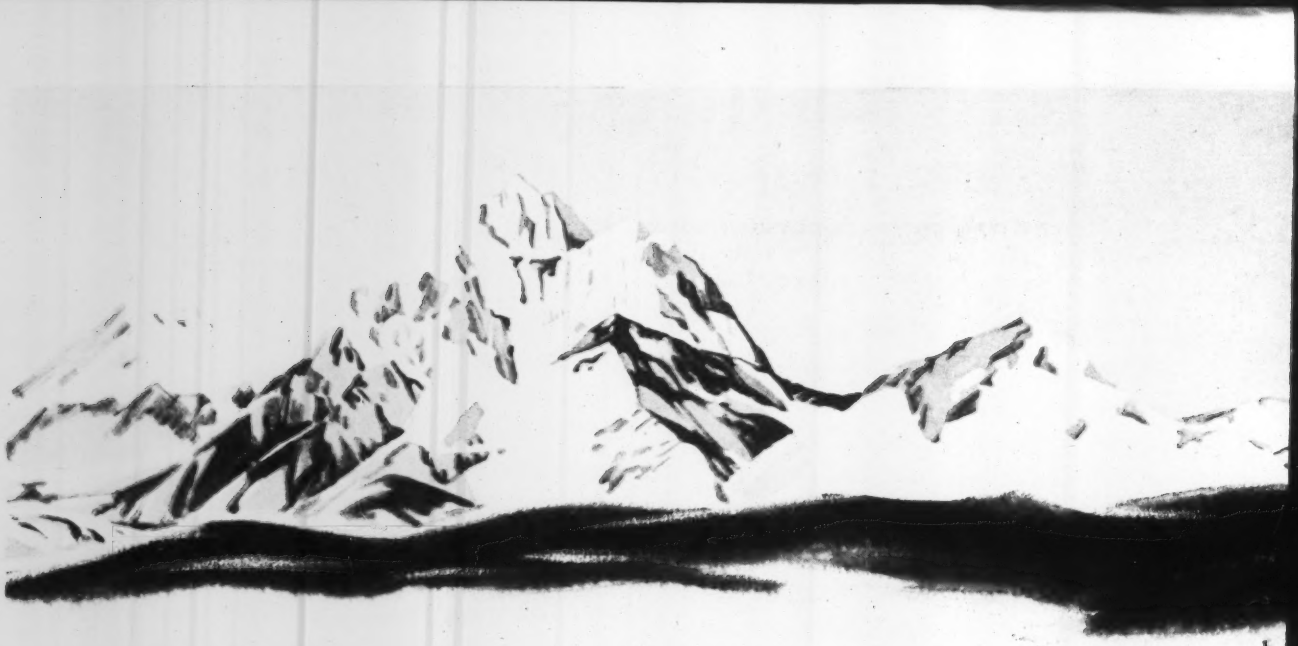

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Challenge . . . that's what lead Acme to seek new heights to conquer. For Acme had achieved its summit as manufacturers of refrigeration and air conditioning components . . . evidenced by the fact that all the leading names in air conditioning have used Acme components for years.

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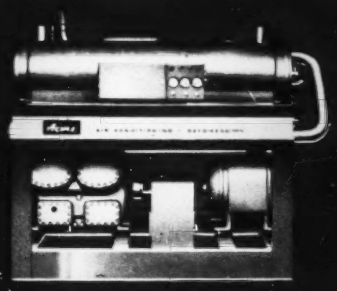

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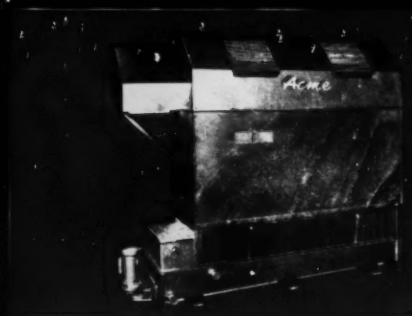

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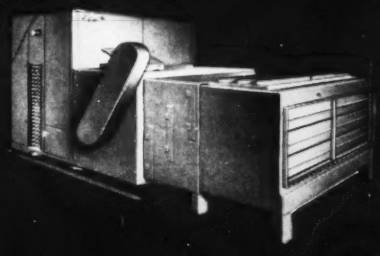

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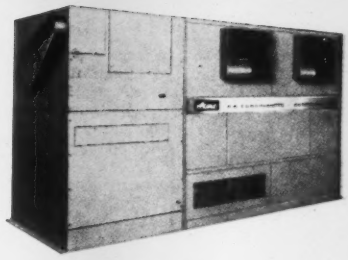
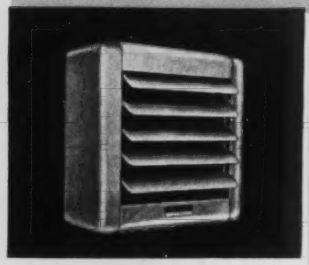


Speaking of FLEXIBILITY...

UNIVAC® computer confirms

Can you think of a need that calls for a unit heater — steam, hot water, gas, or electric — which can not be met by one of these Nesbitt units? If you do, let us know; we may add to our line. Meanwhile, with more than 40 years of proved excellence in *this* line, why not make Nesbitt your name to go buy?

STEAM & HOT WATER



1,084 ways to employ Nesbitt Propeller Fan Heaters

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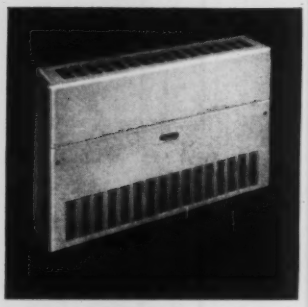

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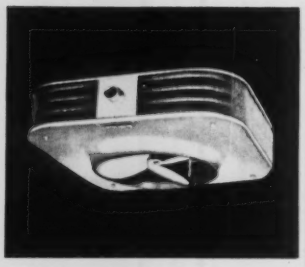
Series A: versatile high-capacity units; seven basic sizes (265 to 1860 cfm) for steam (71 to 545 sq. ft. edr) or hot water (9.1 to 120 mbh); recessed, semi-recessed, or non-recessed models; floor, wall, ceiling and inverted mountings—*Publication 403.*



5,170 ways to employ Nesbitt Little Giant Heaters

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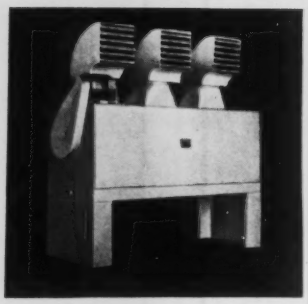

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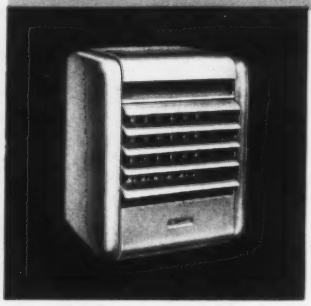

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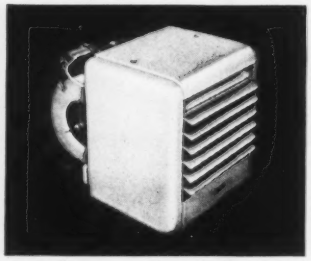
Lightweight and more compact, the new Series K gas-fired unit heater is versatile and attractive. 25,000 to 250,000 Btu/hr input. Sound code rated—*Publication 400.*



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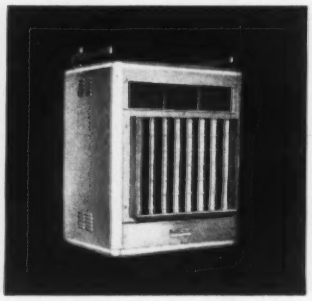

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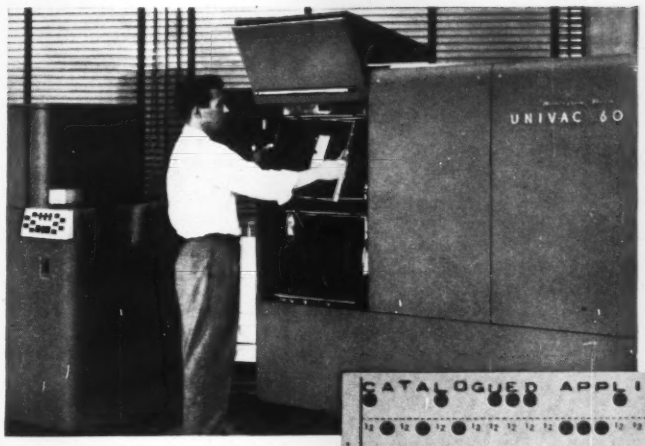
Efficient, automatic gas heating for use with air-conditioning units or with custom ductwork in heating and processing. Six basic sizes, 80,000 to 250,000 Btu/hr input; aluminized steel or stainless steel heat exchanger—*Publication 400-3.*



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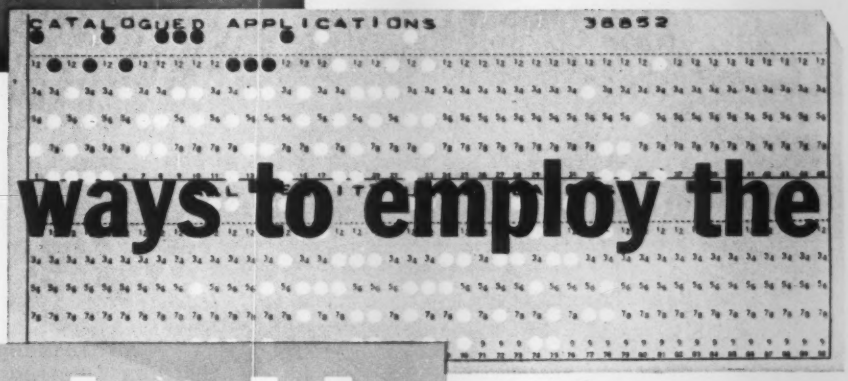

38,852 ways to employ the Nesbitt complete line of UNIT HEATERS

Fantastic? Not at all! Considering all the basic sizes, installation arrangements, types and capacities of heating elements, fan speeds, and discharge outlets, there are actually 38,852 catalogued situations in which at least one of the broad line of Nesbitt Unit Heaters will meet the demands with complete satisfaction. What more could you ask?

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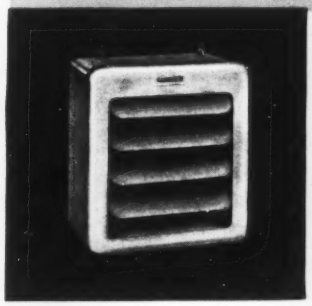
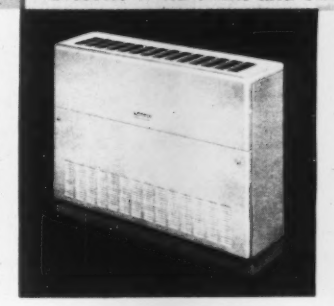
Also available in electric: Nesbitt Syncretizer and Thermovent heating and ventilating units; Nesbitt Wind-o-line and Sill-line radiation.



28 ways to employ Nesbitt Propeller Fan Heaters

Fast and efficient heat, automatic or manual control; in four basic sizes, 14 models; capacities from 5,118 to 122,832 Btu; replaceable black-heat elements; totally enclosed motors; quiet Q-type fans—*Publication E401.*



2,790 ways to employ Nesbitt Electric Cabinet Heaters

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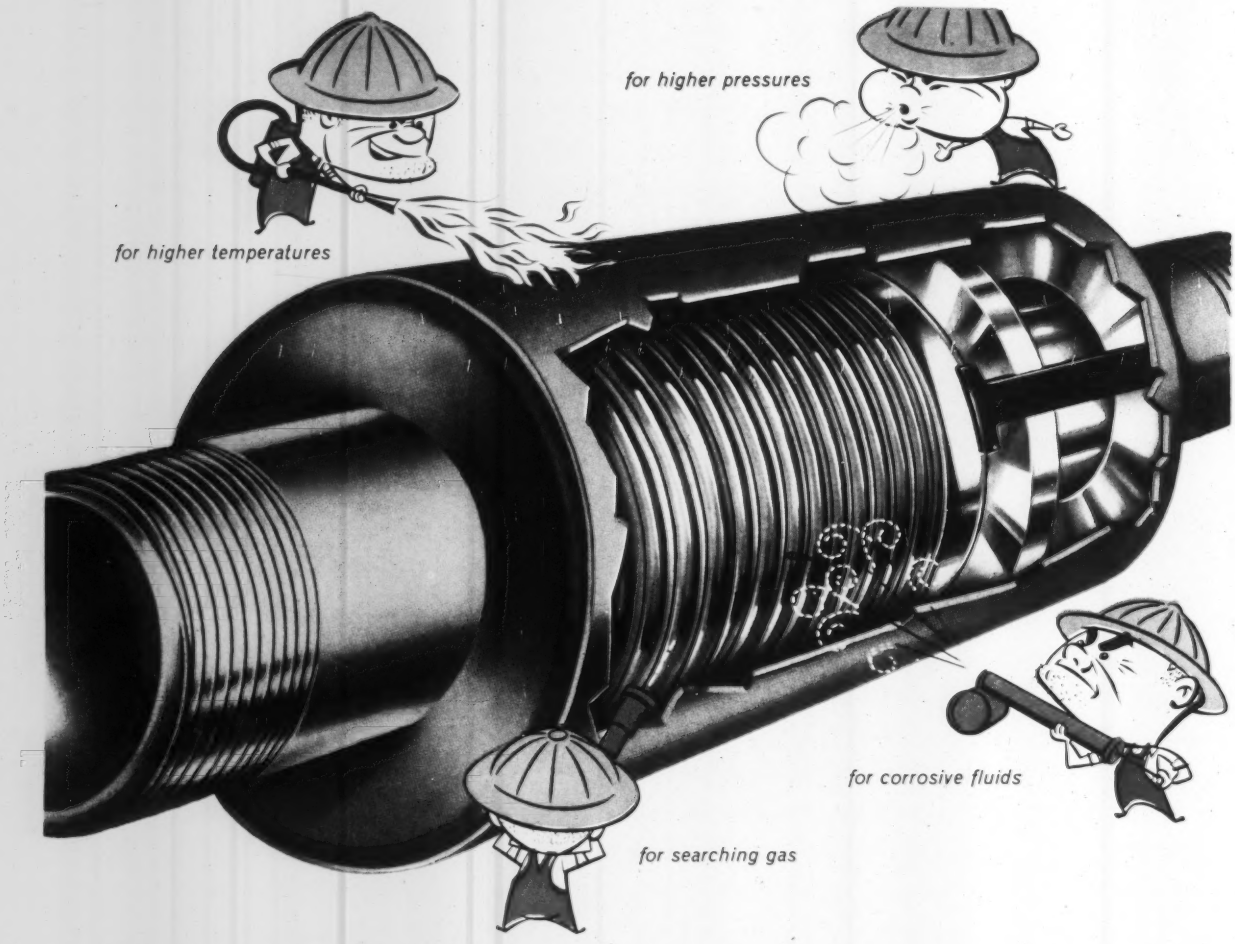

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Screwed, welding, or flanged ends; heavy-duty two-ply Flexonics bellows; positive anti-torque design; and protective shroud . . . all are of stainless steel, to absorb up to 2" pipe expansion under corrosive conditions, at working pressures up to 175 p.s.i., temperatures up to 750°F. Pipe sizes ¾" to 3".

Inch for inch, this is your simplest, lowest-cost way to take up pipe motion under difficult operating conditions. Completely packless, it never needs maintenance. Designed to outlast the piping system you install it in. Also Model H – carbon steel construction with stainless steel bellows; and Model HB – all bronze.

Make Flexonics Expansion Compensators a cost-cutting part of your next piping job.

Write for informative and helpful Catalog No. 205.

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LETTER FROM THE EDITOR

October 1959

Dear Reader:

Proper air conditioning noise control is more than just reduction of noise. As explained by Clayton H. Allen in his article on pages 103 to 108, it really is the adjusting and shaping of the noise background to meet the demands for speech communication, for privacy, and for comfort. The success of a noise control solution depends upon evaluation of the problem early in the planning and design of the system. He points out that the final results depend upon close attention to details in the installation of all noise control means. Dr. Allen presents some fundamental information on the subject of noise in this article, explaining the measurement of noise, and outlines some of the design considerations in noise isolation.

High temperature hot water serves both comfort and process needs in a new plant as discussed by Rollin R. Eiber and William S. Rogers on pages 109 to 111. They explain their reasoning behind the decisions to use this method and cite the highlights of the design. This is one of the first applications of HTHW for process plating equipment. Primary heating is supplied by two 25 million Btu per hr hot water generators equipped for firing with combination burners using No. 6 fuel oil or natural gas.

The design of the snow melting system for the 18,400 sq ft sloping driveway serving the Minnesota Department of Highway's new central office building is explained by John Rudberg in his article on page 112. Provisions for snow melting on this sloping driveway were necessary to keep the building loading and unloading areas open the year 'round. An ethylene glycol solution heated by a shell-and-tube steam converter is circulated through the system. The installation procedures followed, how the system is controlled, the steps taken to guard against slab cracking, and how the system was designed to combat heavy drifts at the retaining wall are explained by Mr. Rudberg.

Air conditioning for modern ships presents many unusual problems as explained by Lewis Smith in his article on pages 114 to 117. Some of these factors are the humid salt air, mobility of the ship, the small size of staterooms, lack of duct space, special ventilation requirements, and watertight bulkheads. Mr. Smith describes the two most commonly used systems which are being used in passenger liners and cargo ships to provide comfort for crew members.

Brushing up on hot water heating fundamentals this month is on the subject of converters as prepared by F. F. Stevenson. The article begins on page 118.

Calculating contraction stresses for missile piping is discussed by K. Hao Hsiao in his article on pages 122 to 124. He explains how the stresses can be determined for piping systems handling liquid oxygen and liquid nitrogen where temperatures of -320 F are encountered. He also compares the results from this procedure with those derived by use of the Kellogg method.

Sufficient makeup ventilation air properly heated and introduced at the right level in an industrial plant is most essential to keep plants from being air starved, as explained by B. R. Small on page 127. If sufficient makeup air is not provided, air will try to get in around windows and wherever it can get in to replace the large quantities of contaminated air being exhausted to the outside. This is a primary cause of discomfort in many plants. Mr. Small presents some basic considerations in the correct design of these systems so that worker comfort will result.

The cost for heating hospitals will be much lower if full insulation and double glazing is used, according to Charles F. Neergaard in his article on page 130. He illustrates this premise with several case histories where hot water radiant heating has been used with success. For several years he has been advocating the use of "complete" insulation for hospitals, and now he reports that a number of new buildings are being planned with full insulation, double glazing, and hot water radiant heating.

A new formula for predicting the performance of counterflow cooling towers is presented in the article by William T. Lyons on pages 134 to 137. Only a single determination of performance either from one operating point or a test rating is necessary for use with this new formula. With this new formula it is not necessary to wait for design conditions to occur to determine whether a cooling tower will perform as specified. Also, there need not be any doubt as to whether an increase in the range (entering and leaving water temperature difference) on an existing tower is economically feasible. The new equation is applicable for tower leaving water temperatures at or above 70 F and tower entering water temperatures at or below 110 F. The water and air quantities must remain constant for both the predicted performance and the test or rating results. Two examples are also given illustrating how the equation is used.

Pressure losses in refrigerant piping systems is discussed by W. C. Smith on pages 138 to 140. Mr. Smith outlines three necessary steps that should be followed to keep these losses due to friction at a minimum. First, he shows how to calculate the pressure losses; next he shows how to predict what effect these losses will have on the performance; and third he explains how to control the magnitude of these losses and keep them low. Mr. Smith stresses the importance of designing refrigerant piping systems with complete knowledge of the effect of pressure losses and how the refrigeration capacity can be affected. Also, the installation must be made carefully to keep the piping clean so the pressure losses will be kept low.

What air conditioning means to America's way of life -- and how essential it is to the health, productivity, and defense of the U. S. -- will be highlighted at a conference in Atlantic City on November 3. This conference is to be held at the time of the 11th Exposition sponsored by the Air-Conditioning and Refrigeration Institute, scheduled for November 2 through 5. A Show Section containing brief descriptions of the displays that will feature air conditioning equipment, products, or supplies has been compiled and is presented on pages 141 to 150. A list of all exhibitors and their booth numbers, along with a floor plan of the exposition, is included.

When man is flung into space in an orbital vehicle, every possible factor in his environment will have been accounted for in the design of the space vehicle cabin. The design of this environment falls largely to the air conditioning engineer experienced in environmental control. The HPAC Engineering Data File this month (pages 151 to 166) has been prepared by Herbert H. Christman and he presents the design factors that must be considered in providing a space crew with an acceptable environment. Important ones include oxygen supply and pressurization, evaluation of the heating and air conditioning loads, and cosmic radiation. Some types of air conditioning systems that can satisfy the requirements of an orbital vehicle are presented, although it must be realized that these are basic considerations and represent current thinking on the subject that may be changed as developments in this rapidly changing field occur.

Question of the Month is on pages 96 and 98 and gives two methods for figuring supports for a horizontal tank. The HPAC Data Sheet is on pages 125 and 126, and the You'll Want to Know news reports are on pages 41 to 46. "Open for Discussion" is on pages 93 and 94, and The Law and Your Profits is on page 133.

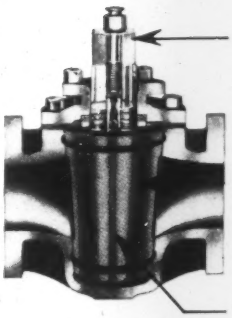
Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

Get pin-point throttling accuracy on chilled water lines . . .

SIZES TO 36": Lines above 8" are no longer a problem. Specify sizes and pressure rating to meet your design needs.

COMPACT: No bonnet cavity or rising stem saves weight and space.



PERFECT BALANCE: Plug is smoothly, easily positioned for precise throttling . . . wrench shows degree of throttle.

THROTTLE or SHUT-OFF: If desired, shut-off valve can be eliminated downstream from throttle valve. Positive shut-off assured by pressurized lubricant.

NO CHANCE OF CHATTER: Solid tapered plug is perfectly seated in rugged body . . . no exposed seats . . . silent for the life of the building.

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More and more air-conditioning design engineers are assuring operating efficiency by insisting on Rockwell-Nordstrom valves to balance chilled water lines. A few of their reasons are illustrated in the cut-away valve pictured at the left . . . reasons that have been proved sound, practical and economical in air-conditioning installations everywhere. You can get complete details on Rockwell-Nordstrom valves for a wide variety of heating and air-conditioning applications by sending the coupon below. Better yet, why not have a Rockwell Field Engineer call on you? Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee, Peacock Brothers Limited.

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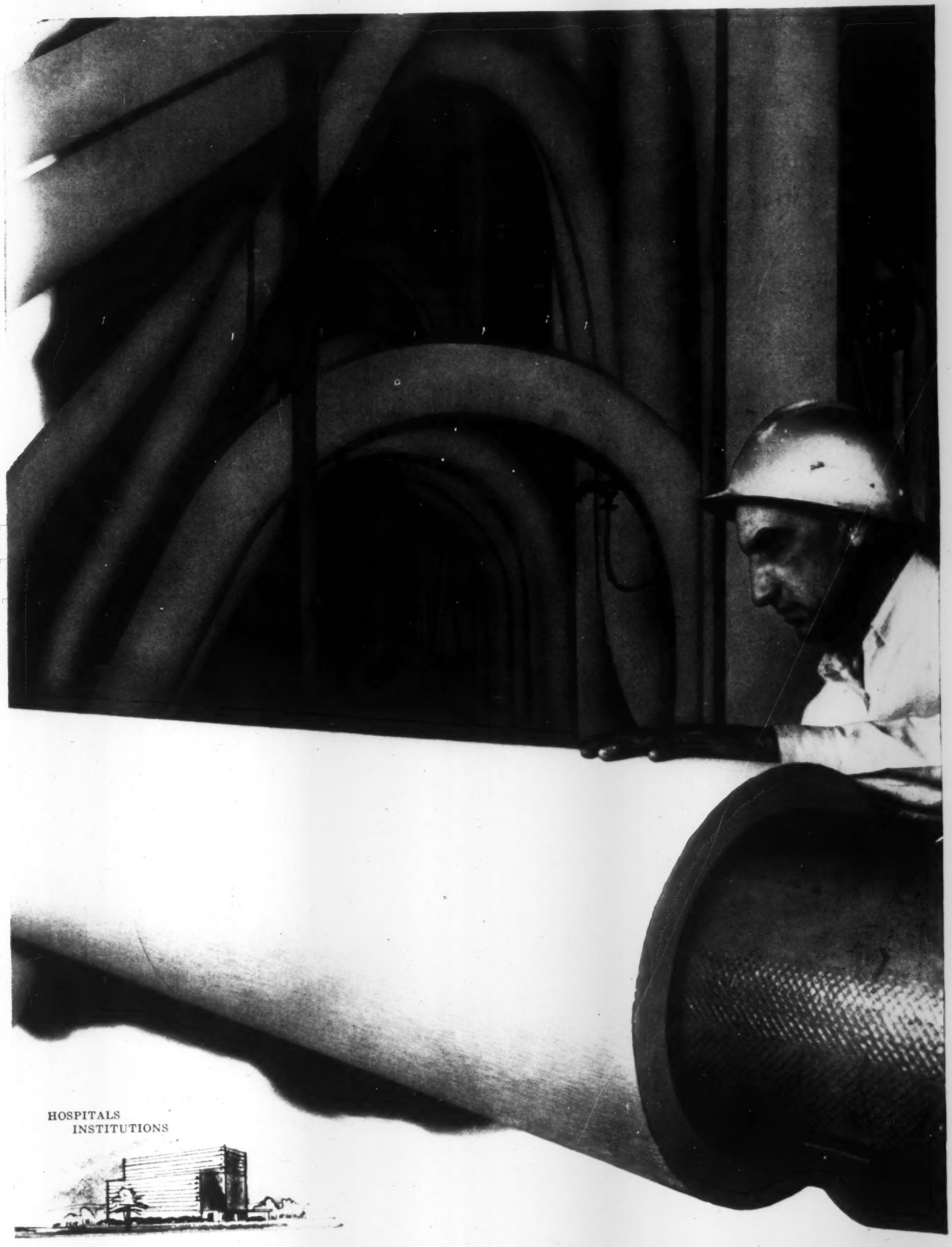

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for gas-fired boilers and furnaces...

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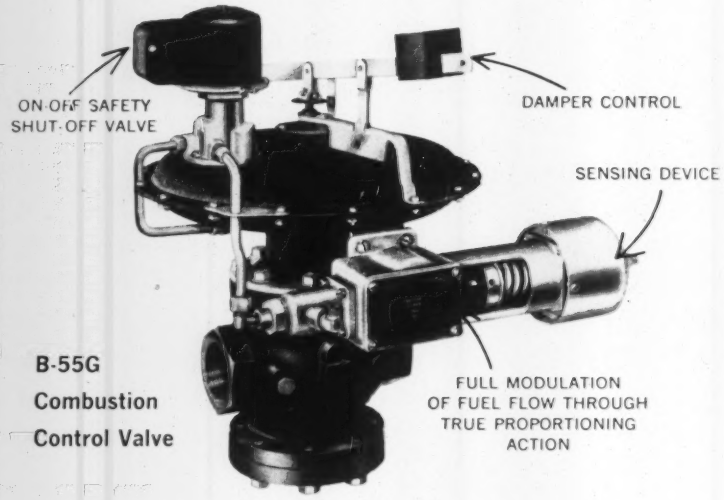
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FULL MODULATION OF FUEL FLOW THROUGH TRUE PROPORTIONING ACTION

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Check the features to the left – then compare them item for item against *any* comparable combustion control system on the market. And to save yourself time and money, do it *before* you do that next installation or change-out. You'll find feature for feature, dollar for dollar, the General Controls B-55G is the best buy, every time. Immediate response to load changes in steam, hot water, or warm air systems – pressure and temperature ranges to 600 psi and 700°F. Sizes 1" to 6". Fully approved by AGA and UL. Let us send you complete information – or check the yellow pages for your nearest General Controls Factory Branch Office.

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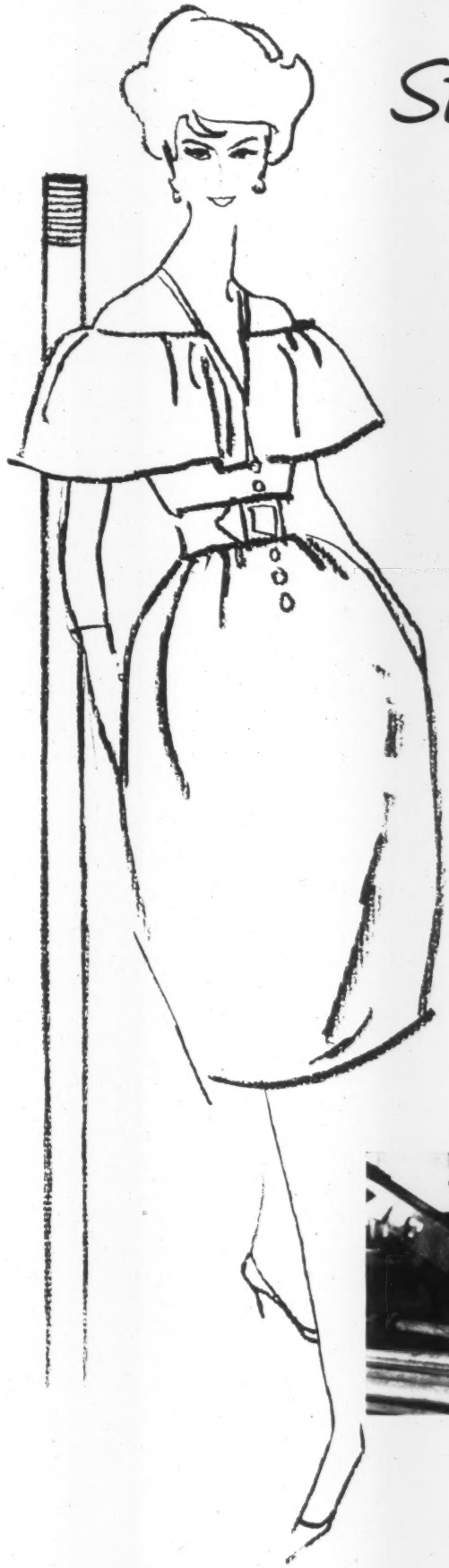


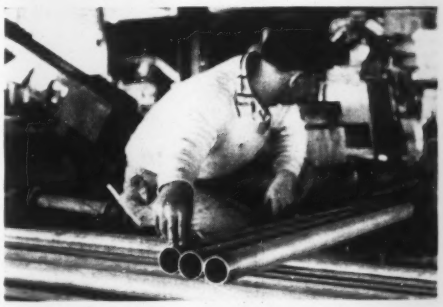
Steel Pipe's in Fashion at Bullock's Santa Ana

General Contractor—C. L. Peck Construction and Realty Company; Plumbing Contractor—Mehring and Hanson Company; Pipe Jobber—Grinnell Co. of the Pacific.

Fashion Square is unique. It's the first large shopping development in the country to be devoted primarily to modern fashion, both in wearing apparel and home décor. Covering 45 acres in Santa Ana, California, it was conceived and built by Bullock's, Inc.

Steel pipe serves Fashion Square's main building, Bullock's Santa Ana, where Beth-Co-Weld was installed for the plumbing and heating lines, vent lines, and in the fire sprinkler system. Today, top builders use steel pipe because it's low in cost, quickly installed, long in service. And Beth-Co-Weld is steel pipe at its best.

On your next job, use Bethlehem steel pipe. You can be sure it will do the best possible job at the most reasonable cost.



Bethlehem steel pipe works easily, installs fast. Beth-Co-Weld is furnished, black or galvanized, in sizes from ½ to 4 in., nom., and in uniform 21-ft lengths, ± 1-in., as well as in random and cut lengths. Larger diameters are produced by Bethlehem as electric resistance-weld steel pipe.

BETHLEHEM STEEL COMPANY
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NEW MODINE ... Perma-Trim WALL-TO-WALL CONVECTORS

★ KEEPS IT NEAT
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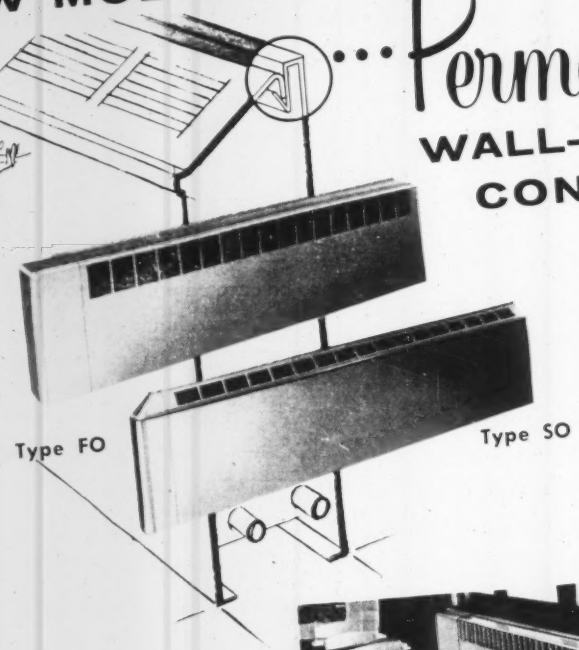
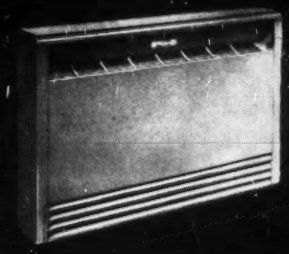


Here's the finest of convector comfort . . . with no installation headaches! Modine's exclusive *Perma-Trim* improves appearance by minimizing problems caused by wall irregularities. There's no wall streaking . . . no breaking of paint bond between convector and wall when front panel is removed. And you can install *Perma-Trim* wall-to-wall convectors directly beneath window sills.

Bulletin 259-A has full facts. For your copy, and data on any other products on these pages, see your Modine representative, or write Modine Manufacturing Co., 1509 DeKoven Ave., Racine, Wisconsin.

AIR CONDITIONING... MODINE"



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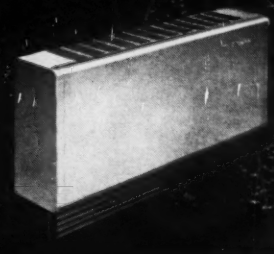

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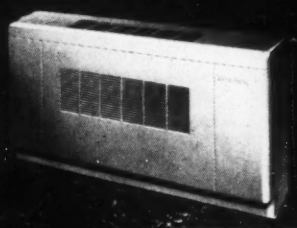

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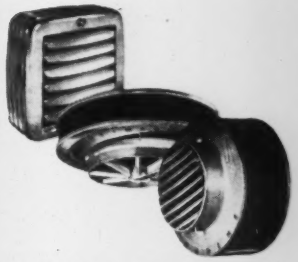
. . . the world's most complete unit heating line



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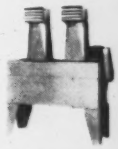

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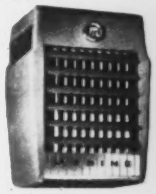

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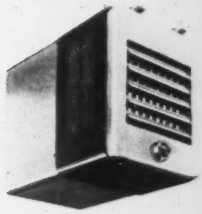

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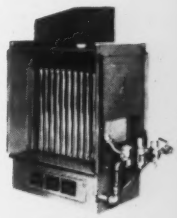

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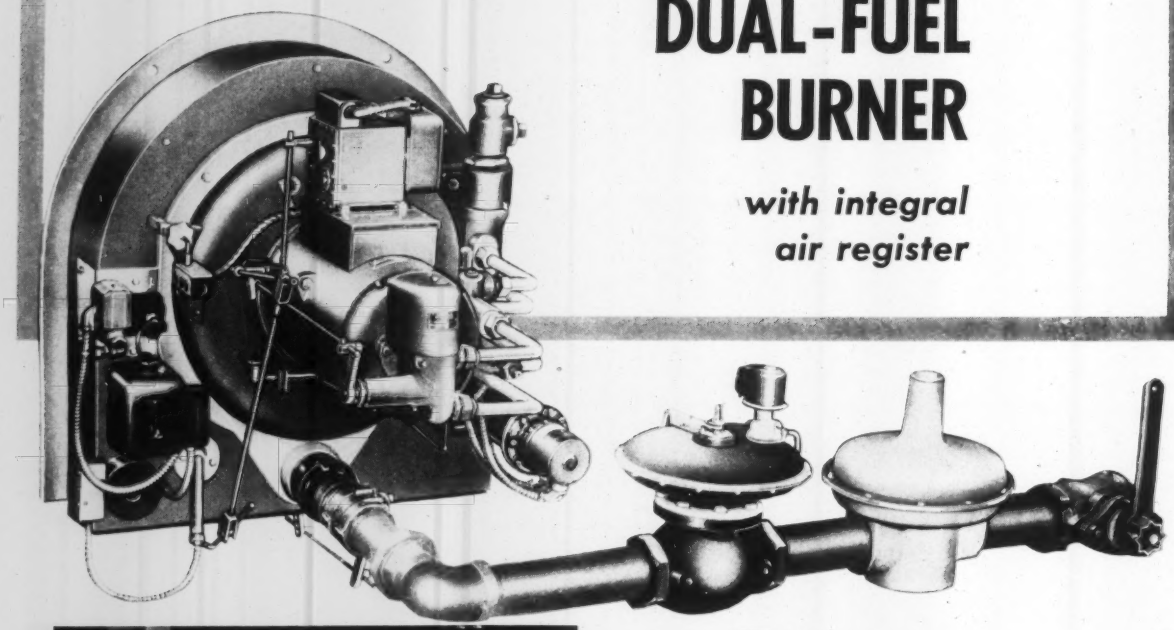
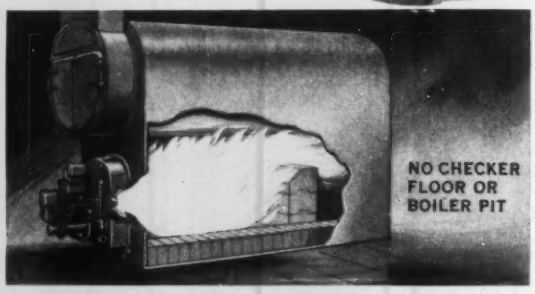
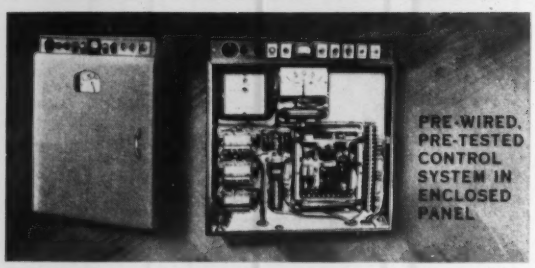
with integral air register







For natural or induced draft firing

The secondary air register is built into the burner!

The effect of this is plain to any heating engineer—no special construction is required to supply air to the combustion chamber. No draft door, no boiler pit, no checkered floor. Also the critical refractory combustion throat (so vital to efficient combustion) is pre-formed at the factory—you take no chances on local fabrication.

The burner (for either oil or gas, or dual-fuel combination) is remarkably free from mechanical complexities. It handles the heaviest oils or any type of gas with precision and dependability. *It stays on the job.*

Complete control systems are available from the factory. They are designed, built and tested with the same degree of care that the burner receives. The factory-integrated combination of the burner package and control system package provides maximum skill and undivided responsibility for the complete firing system.

Capacities: 30 to 450 boiler hp, gas or oil.

For further information, please mail coupon.

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Please send me literature and specification sheets on money-saving Petro Gas-Oil Burners.

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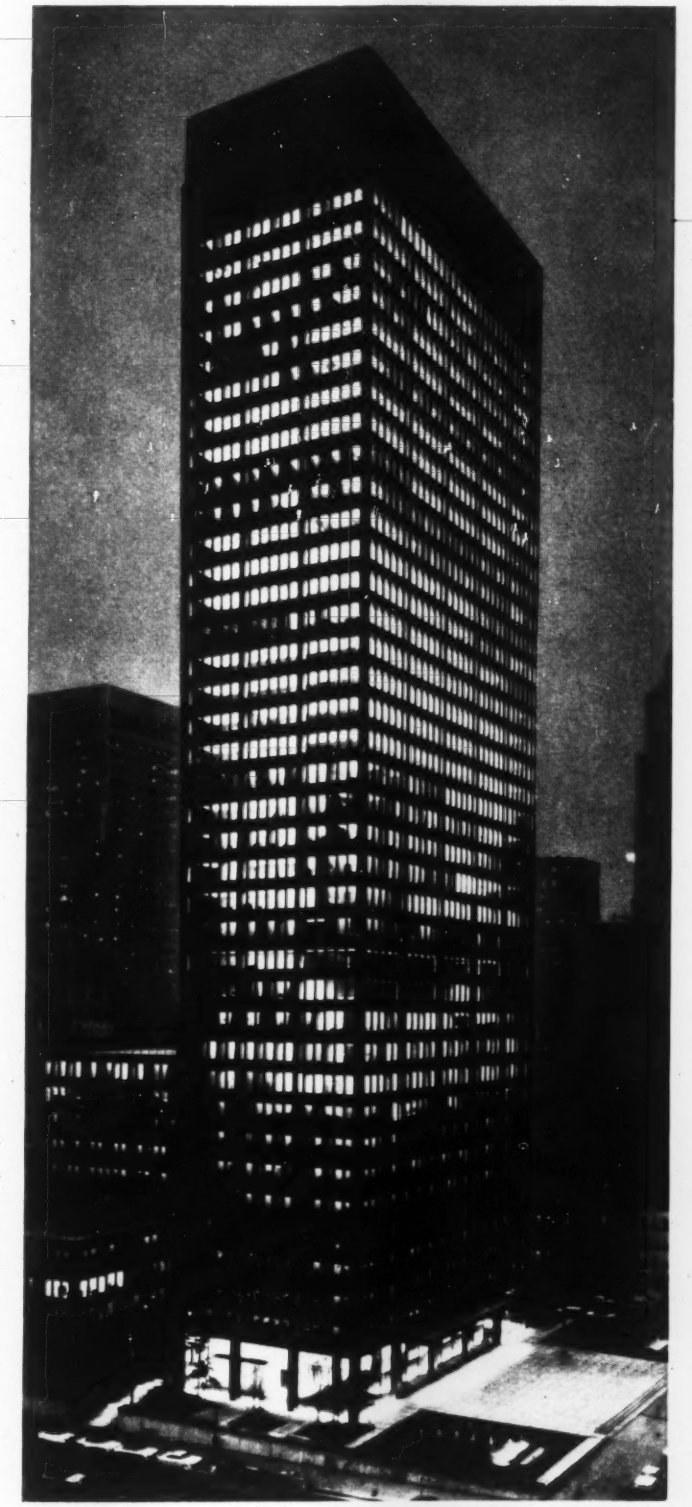

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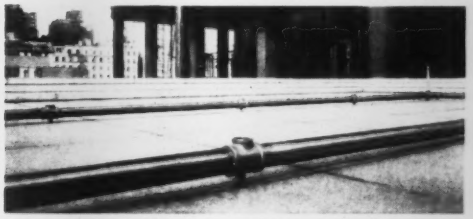
A vital network of Phelps Dodge Red Brass Pipe—roughly 17 miles of it—runs through the magnificent new bronze office building at 375 Park Avenue in New York. From street level to the top of this striking skyscraper, the maze of piping carries the hot and cold water needed for the 38-story structure's mammoth plumbing system.

A number of especially designed water fixtures, including a unique central drinking water system, are connected to these Phelps Dodge pipes. Other PD pipes under the park plaza supply water to the graceful fountains and pools in front of the building.

Plumbing contractors know that the famous Phelps Dodge "Mine-to-Market" quality line of copper tube and pipe more than meets every requirement for modern plumbing systems. That's why they specify Phelps Dodge for every kind of installation —from skyscrapers to homes!



Red brass pipe in pool bottoms on building plaza furnishes water for beautiful fountain displays.

Quality tube sold the quality way—through authorized wholesalers!

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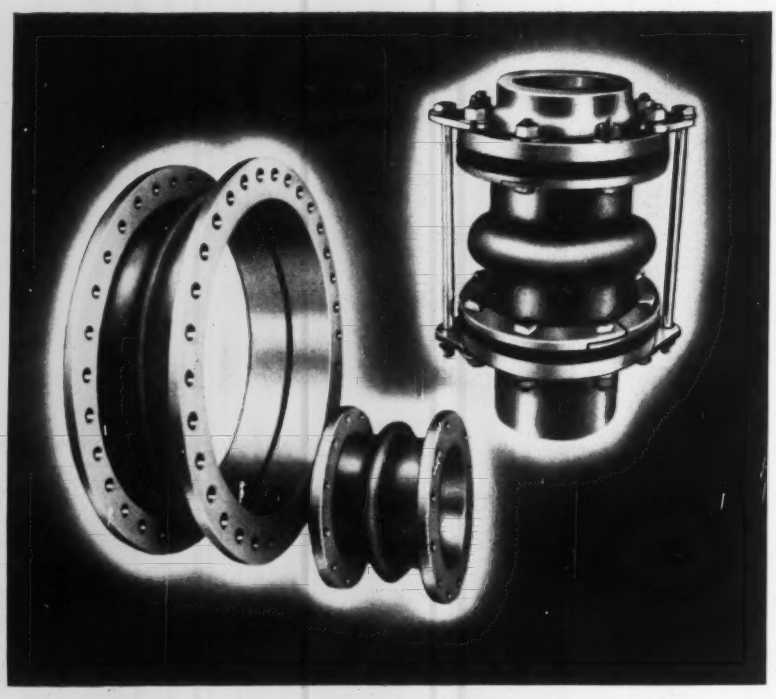
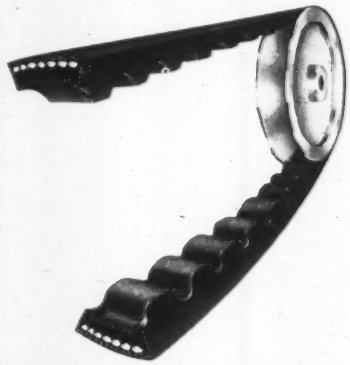


R/M Rubber Expansion Joints and Pipe Solve Piping Stress and Vibration Problems

Repeated flexing caused by changes in temperature can put dangerous strain on pipe, fittings and associated equipment used in modern ventilating and air conditioning systems. R/M Rubber Expansion Joints *absorb* this movement . . . prevent stress caused by expansion and contraction . . . eliminate costly maintenance problems inherent with conventional pipe joints. At the same time they *insulate* system pumps, blowers, compressors and similar equipment against transmission of destructive vibration and noise. Rubber joints also avoid misalignment where space is limited . . . or where equipment may be operating above rated capacity.

On pipe lines subject to noise, vibration and electrolysis, Condor Flexible Rubber Pipe outlasts iron or steel . . . permits easy installation that eliminates pipe joint leakage.

You get more dependability and economy with Manhattan Rubber Expansion Joints and Condor Flexible Rubber Pipe than possible with other methods . . . "More Use per Dollar" in handling water, steam, other fluids and gases. Let an R/M representative demonstrate these engineered advantages for your heating, cooling or other application. Write for Bulletin M685.



NEW R/M CX V-BELT*

- EXTREMELY QUIET . . . VIBRATION-FREE
- ONLY FULLY-MOLDED, FULLY-JACKETED LUGGED V-BELT
- FOR SMALL PULLEYS
- FLEXIBLE, STRONG, RUGGED
- OUTLASTS OTHERS UP TO 8 TO 1
- NO FLEX-CRACKING
- HOLDS SHAPE AND EFFECTIVE LENGTH WITHOUT STRETCH

*Made for original equipment. Patented.

CONDOR V-BELTS

For heavy industrial multiple belt units

- PRECISION MADE
- SMOOTHEST RUNNING V-BELTS MADE
- MORE GRIP, LESS SLIP
- LONGER, TROUBLE-FREE SERVICE
- LOWER DRIVE COSTS

R/M POLY-V® DRIVE

Single, Parallel V-Ribbed Belt

- MORE POWER — LESS SPACE
- CONSTANT SPEED RATIO
- ELIMINATES MULTIPLE V-BELT "MATCHING" PROBLEMS
- LESS BELT AND SHEAVE WEAVE
- LESS INVENTORY (2 cross sections instead of 5)

"More Use per Dollar"

WRITE FOR DESCRIPTIVE BULLETINS

®Poly-V is a registered Raybestos-Manhattan trademark. Patented.

RM 938

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

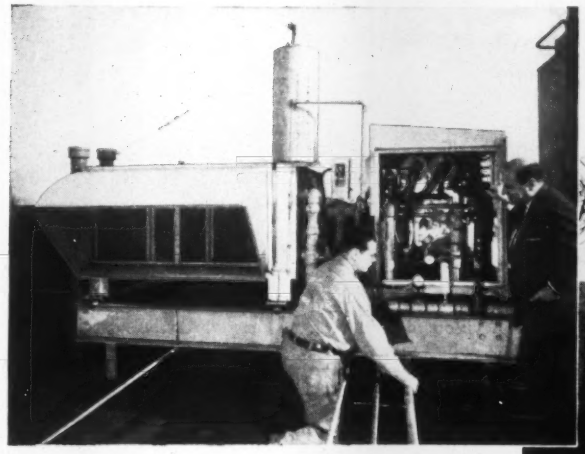
RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

HIGH IN THE SKY...

DUNHAM-BUSH

Air Conditioning Installation for Hospital's "HEART" Below



MOTHER CABRINI MEMORIAL HOSPITAL
New York City, New York
Supervisor: Mother Charitas, MSC

Contractor: Edison Cooling Systems, Inc.
Wholesaler: Albert Hofeld, Inc.

Vital to all hospitals is efficient and uninterrupted functioning of operating rooms, doctors and nurses scrub rooms . . . "heart" of the institution's activities.

High on the roof of New York's Mother Cabrini Memorial Hospital is a complete outdoor installation for air conditioning these important areas. The entire system was installed during a normal working day with practically no loss of operating time.

Dunham-Bush sales engineers worked closely with hospital authorities and suppliers to insure a highly efficient system that could be easily installed. All Dunham-Bush equipment including package chiller with pump, air handling unit and Brunner-Metic compressor insure dependable operation for years to come.

You are assured of the best when you deal with Dunham-Bush for hospital air conditioning and heating. Send for data on Dunham-Bush's many contributions to better hospitals throughout the country.

Dunham-Bush, Inc.

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

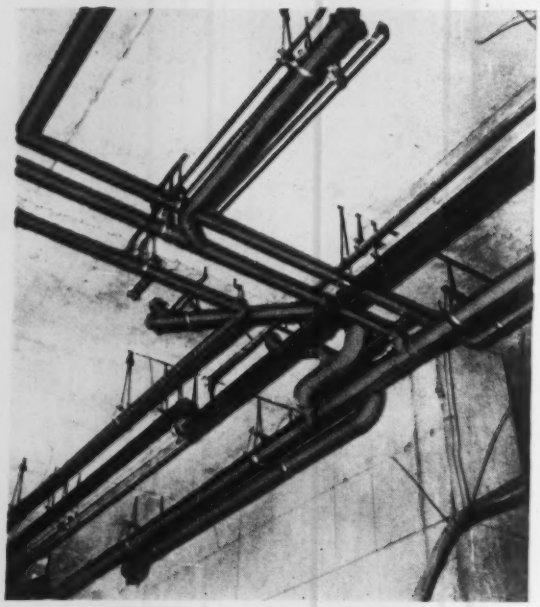
WEST HARTFORD, CONNECTICUT • MICHIGAN CITY, INDIANA
MARSHALLTOWN, IOWA • RIVERSIDE, CALIFORNIA
SUBSIDIARIES

heat-x HEAT-X, INC. BREWSTER, N.Y. | Brunner THE BRUNNER CO. WEST HARTFORD, CONN. | Dunham-Bush DUNHAM-BUSH (CANADA), LTD. TORONTO, CANADA

Dunham-Bush DUNHAM-BUSH, LTD. PORTSMOUTH, ENGLAND | Brunner BRUNNER CORPORATION (CANADA) LTD. PORT HOPE, ONTARIO

EASY TO HANDLE. Mechanic easily connects a length of 6-inch copper tube. More than 16,000 pounds of Anaconda Copper Tube, Type M, in sizes up to 8 inches, was used for the sanitary drainage systems. Architect and Engineer: California State Division of Architecture. Mechanical Engineer: Division of Architecture. General Contractor: Robert E. McKee, Inc., Los Angeles. Plumbing Contractor: E. O. Nay, Inc., Pasadena.

COMPACT COPPER SANITARY DRAINAGE SYSTEM GIVES NEW CALIFORNIA HOSPITAL MORE USABLE SPACE



CLOSE WORK LIKE THIS is possible only with copper tube. Water and drainage lines hug the ceiling, giving ample basement headroom. Even in tight quarters, connections are easy to make. Sizes in this photo range from ¾" water lines to 4" for drain and vent lines.

Copper tube sanitary drainage lines in the hospital building and administration wing of the new Fairview State Hospital at Costa Mesa, California, eliminated wasted space in furred areas and allowed ample headroom in the basement. Equally important to the project owners, however, was the fact that copper tube drainage systems are easier to install, are long lasting, require less maintenance than other materials.

Copper tube was used also for the hot and cold water lines and for the radiant heating system.

TREND TO COPPER "The factors important to us as mechanical contractors are the work-saving features of copper tube. It has proved to be easier to handle, more adaptable to space problems, less trouble to test, and as a consequence, faster to install than other methods considered standard." B. J. Sabin, Manager, E. O. Nay, Inc., plumbing contractor on Fairview State Hospital.

Specify Anaconda Copper Tubes and Fittings — Types K and L for water supply and heating lines; Type M and the new lighter weight Type DWV for sanitary drainage systems. Anaconda wrought and cast solder-joint fittings for pressure and drainage applications. Write for Publication C-33. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

68807

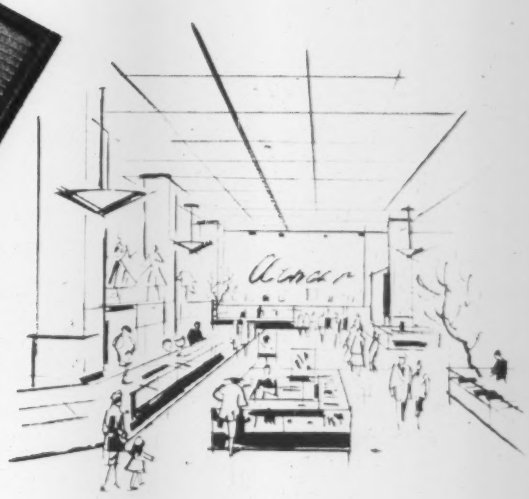
ANACONDA® **COPPER TUBE AND FITTINGS**

PRODUCTS OF THE AMERICAN BRASS COMPANY

Available through plumbing wholesalers

Now—

a new PLIOTRON filter for every filter job



at ordinary filter prices

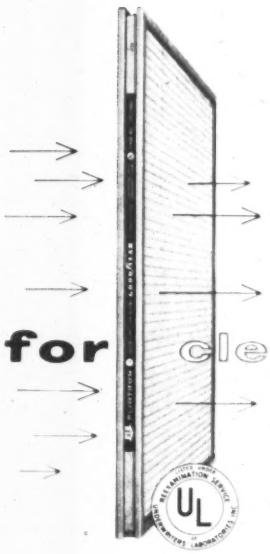
The new PLIOTRON CR filters do an unmatched air-cleaning job in all normal installations. They clearly outscored competitive makes in dirt-arrestance tests. And they're available in both regular and special sizes.

Then, for critical installations that call for a maximum-efficiency filter, there's the new PLIOTRON HD. It's the most efficient panel filter ever developed.

PLIOTRON filters are not ordinary surface-loaders—they're depth-loaders. Their electrostatic action helps *trap* the dirt ordinary filters only *sift*. And they last indefinitely—a quick bath will restore them to like-new efficiency.

Word quickly gets around on super-filters like these—one installation sells another and another. So it's easy to see what business-builders the complete new line of PLIOTRON filters promises to become.

For the complete story on the new PLIOTRON CR and HD filters—covering every filtering requirement—write Goodyear, P.O. Box 288, Akron, Ohio.



for cleaner air everywhere-

NEW PLIOTRON AIR FILTERS BY

GOODYEAR

THE GREATEST NAME IN RUBBER

Pliotron—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

BRUNER Industrial WATER SOFTENERS

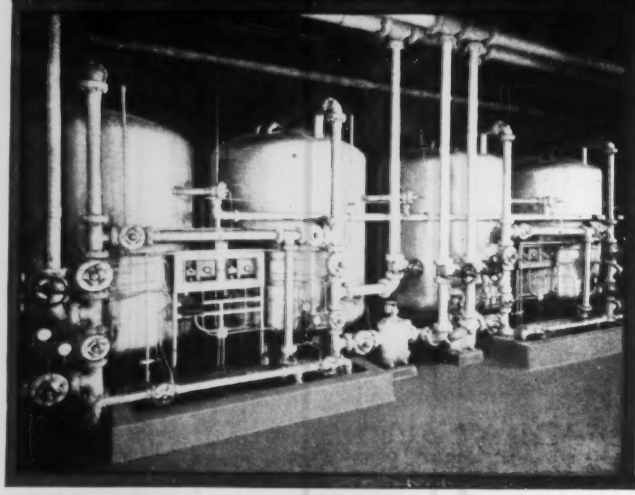
. . . are frequently

SPECIFIED

by leading engineers for important installations

This is Mayfair, Milwaukee, one of the largest shopping centers in America. One of Bruner's largest water softener installations softens all the water — even in the air conditioning system.

Hundreds of Bruner commercial and industrial installations throughout the United States and in many foreign countries are providing trouble-free service in both large and small applications. Water softeners, filters, and other Bruner water conditioning equipment are available for immediate delivery from stock in many types and sizes. Custom installations are fabricated to engineer's exact specifications.



The Bruner softeners at Mayfair are fully automatic. Salt storage and brining systems are specially designed. Softener capacity is 13,000,000 grains and delivers 1,750,000 gallons of softened water @ 1200 GPM.

Consulting Engineer: L. R. SCHMAUS CO., INC., Milwaukee, Wis.

Architect: GRASSOLD-JOHNSON & ASSOCIATES, Milwaukee, Wis.

Plumbing Contractor: SEDLET PLUMBING & HEATING, INC., Milwaukee, Wis.

Automatic Industrial type softener carried in stock.

BRUNER WATER SOFTENERS & FILTERS

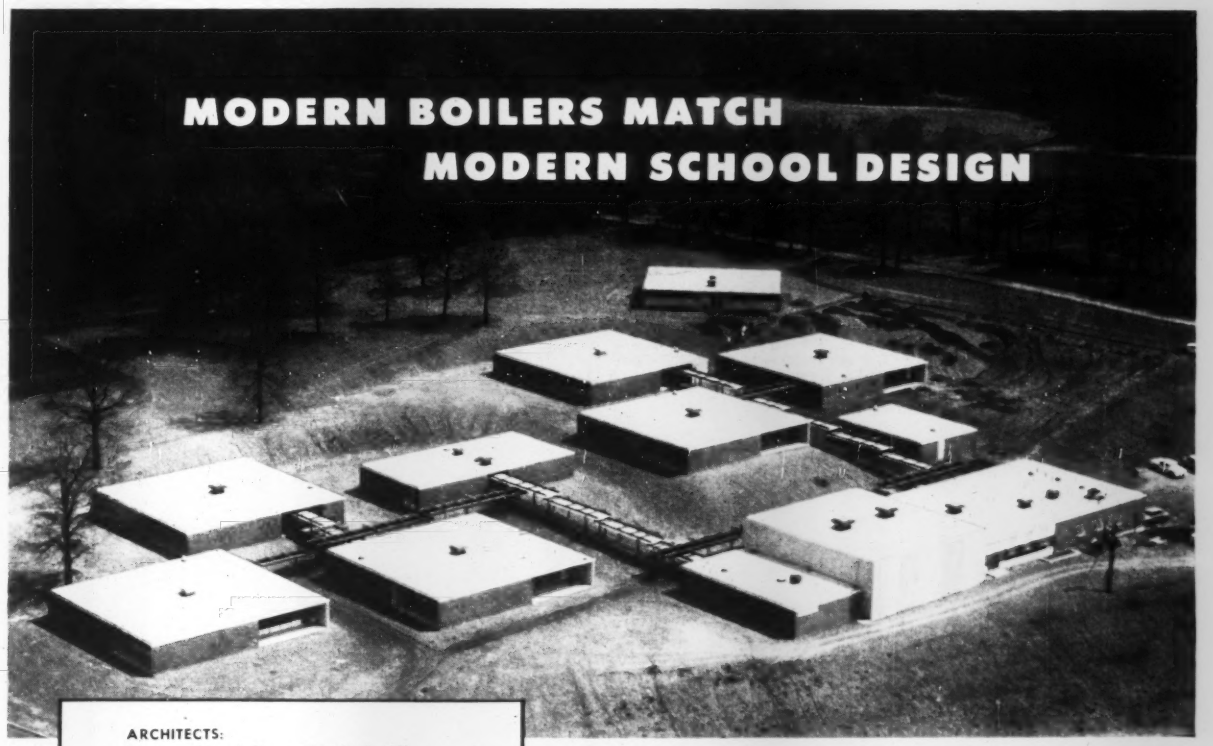
BRUNER CORPORATION

America's most complete line of quality water softeners and filters.

Executive Offices: 4763 N. 32nd ST., MILWAUKEE 9, WIS.
Telephone: HIlltop 2-3200

Plants: Milwaukee, Wis., and Los Angeles, Calif.
Sales and Engineering Offices in all principal cities.

MODERN BOILERS MATCH MODERN SCHOOL DESIGN



ARCHITECTS:
Ketchum, Gina & Sharp, New York, N.Y.
ENGINEERS:
Cosentino Associates, New York, N.Y.
GENERAL CONTRACTOR:
Bregman Construction Co., New York, N.Y.
PLUMBING & HEATING CONTRACTOR:
The Frank Sullivan Co., Boston, Mass.
DISTRIBUTOR:
Joseph H. Young Co., Malden, Mass.

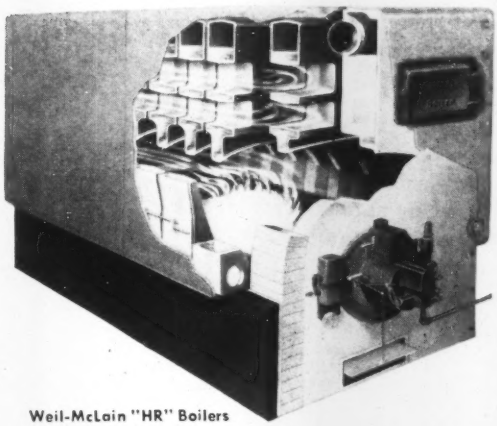
This unit type school at Wallingford, Conn., typifies the new trend in school design and is matched in modernity by its heating plant.

The ten buildings are heated with two Weil-McLain HR44-12 Boilers, developing 162 HP. The boilers supply a forced hot water system circulating through underground piping.

Weil-McLain "HR" Boilers are cast iron sectional units, with all the advantages inherent in this type of construction. They are designed specifically to develop the economies possible with horizontal rotary oil burners using low-cost heavy oils. The large firebox creates better combustion conditions and maximum radiant heat transmission... complete combustion chamber data is available for each size boiler and type of burner. Balanced flue gas travel assures equal distribution of heat to all secondary heating surfaces. Generous waterways permit rapid, efficient water circulation.

Correct installation of the burner is made easy by a special steel front plate and the high base eliminates need for a high brick foundation.

Send for Bulletin C-188. For other Weil-McLain Gas and Oil Boilers, see Engineers' Product File or Sweet's Architectural File.



Weil-McLain "HR" Boilers are available with Certified Ratings of 885,000—2,942,500 BTU/hr.

WEIL-McLAIN "HR"

HEAVY DUTY BOILERS FOR HORIZONTAL ROTARY OIL BURNERS

WEIL-McLAIN BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

Address literature requests to Dept. AA-109

SAVE and SELL
with these
HUSSEY COPPER
TUBING ADVANTAGES

MATERIAL SAVINGS

Copper's durability—one of its outstanding properties—makes it possible to use thinner walled tube with smaller outside diameters for water lines and drainage, vent and waste systems. Result—a saving in both material and space. Its light weight permits handling of longer lengths. Result—fewer fittings. Soldered joints eliminate need for caulking, lead and oakum.

INSTALLATION SAVINGS

With copper, site work is reduced because copper is easy to handle . . . easy to cut . . . requires no threading . . . solders quickly. Its long lengths mean fewer joints and faster fitting in the tight spots. Often, plumbing trees and even complete modular bathrooms can be prefabricated to save installation time and money.

QUALITY SALES FEATURES

Copper is a "sell-word" because customers know it as the sign of quality construction. It is broadly recognized for its long service without costly replacement and maintenance in all its many uses in construction. You can be doubly sure you'll get all the quality features of the ageless metal when you specify HUSSEY —a leading name in copper since 1848.

COPPER HUSSEY BRASS

C. G. HUSSEY & COMPANY

(Division of Copper Range Co.)

ROLLING MILLS AND GENERAL OFFICES
PITTSBURGH 19, PA.

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

7 Convenient Warehouses to serve you

PITTSBURGH (19) 2850 Second Ave.
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NEW YORK, LONG ISLAND CITY (6) 34-39 Thirty-first St.

THE WARREN WEBSTER MAN BRINGS THE SOLUTION TO YOUR HEATING AND COOLING PROBLEMS

Wherever you are, whatever your "thermal environment"—there's a Webster product to assure year-round heating and cooling comfort . . . a Warren Webster Man ready to help you into the Comfort Zone.

Let him study your specific problems and recommend the Webster products that most efficiently meet your comfort requirements. He's pledged to see to it that your installation is right . . . and that it stays right . . . always. The Webster Mobile Demonstrator shows Webster heating and cooling equipment in operation. He'll be glad to advise you when it visits your area.

In the hands of your Warren Webster Man, product dependability and customer service come first. Whatever your heating and cooling problem, call on him . . . today.

WARREN WEBSTER & COMPANY, INC.

HEATING • COOLING

HOME OFFICE & FACTORY, CAMDEN 5, NEW JERSEY • REPRESENTATIVES IN PRINCIPAL CITIES

PROTECT *thermal insulation*

RESISTS WATER, FIRE and CHEMICALS

There's a specialized Foster system of rugged coatings, sealers, and adhesives developed to meet your toughest problem of thermal-insulation protection. Insure your insulation investment throughout your plant—see your Foster Sales Engineer, or outline your conditions in a card or letter.

INSULATION & PROTECTION

IT TAKES BOTH TO DO THE JOB

SOLD BY AMERICA'S LEADING INSULATION DISTRIBUTORS AND CONTRACTORS

foster COATINGS • SEALERS • ADHESIVES for thermal insulation

BENJAMIN foster CO.
Division of Amchem Products, Inc.

4635 W. GIRARD AVE. • PHILA. 31, PA.

standard products for thermal insulation protection

Architect: William B. Tabler, New York, N. Y., Ductwork Fabricator: Limbach Company, Pittsburgh, Pa. General Contractors: Turner Construction Company, New York, N. Y.

USS Galvanized Steel Sheets make strong, low-cost ductwork in the new Pittsburgh Hilton Hotel

Ductwork for the new Hilton Hotel in Pittsburgh is being fabricated from USS Galvanized Steel Sheets by Limbach Company. Galvanized steel was specified for this job because of its strength and economy. USS Galvanized was selected because of its consistent high quality. Because USS Galvanized Steel Sheets are strong and rigid, lock joints stay tight—less soldering or riveting is needed. The rigidity of the steel reduces flutter and vibration and allows longer spans with fewer supports—this makes installation quicker and easier.

USS Galvanized Steel Sheets are easy to form. Even with severe shaping, the zinc will not flake off the base metal because USS Galvanized Steel Sheets have a tight, uniform bond between zinc and base metal.

Save money and improve the quality of your ductwork. Specify USS Galvanized Steel Sheets for your next job. USS Galvanized Steel Sheets are available from local steel service centers.

USS is a registered trademark

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
American Steel & Wire – Cleveland
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

In bowling alleys and banks, bakeries and beauty parlors... You'll find

genetron®

SUPER-DRY REFRIGERANTS

Approved! Accepted! Preferred!

The popularity of bowling has increased so sharply in recent years that today more Americans actively participate in bowling than in any other indoor sport. Air-conditioned alleys have made it possible for bowlers to enjoy the game the year round.

In thousands of applications, you'll find "Genetron" refrigerants filling the air-conditioning and refrigeration needs of modern America. "Genetron" refrigerants offer unexcelled purity and dryness . . . and their strict quality specifications are consistently *bettered* in production. Leading equipment manufacturers, refrigeration engineers and air-conditioning and refrigeration wholesalers approve, specify and recommend them. They know they can always count on "Genetrons" for dependable, trouble-free service.

"Genetron" Super-Dry Refrigerants are available from wholesalers everywhere, coast to coast. See your wholesaler. Insist on "Genetron"!

genetron 11 ORANGE LABEL CCl_3F
TRICHLOROMONOFLUOROMETHANE

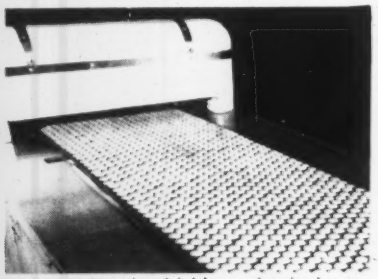
genetron 12 WHITE LABEL CCl_2F_2
DICHLORODIFLUOROMETHANE

genetron 22 GREEN LABEL $CHClF_2$
MONOCHLORODIFLUOROMETHANE

genetron 113 PURPLE LABEL $C_2Cl_3F_3$
TRICHLOROTRIFLUOROETHANE

genetron 114a BLUE LABEL $C_2Cl_2F_4$
DICHLOROTETRAFLUOROETHANE

Air-conditioning is a "must" inside bank vaults, museum and library storage rooms and other areas where, for security reasons, there are no windows or little air circulation. Precise control of temperature and humidity also protects important records against atmospheric variations.



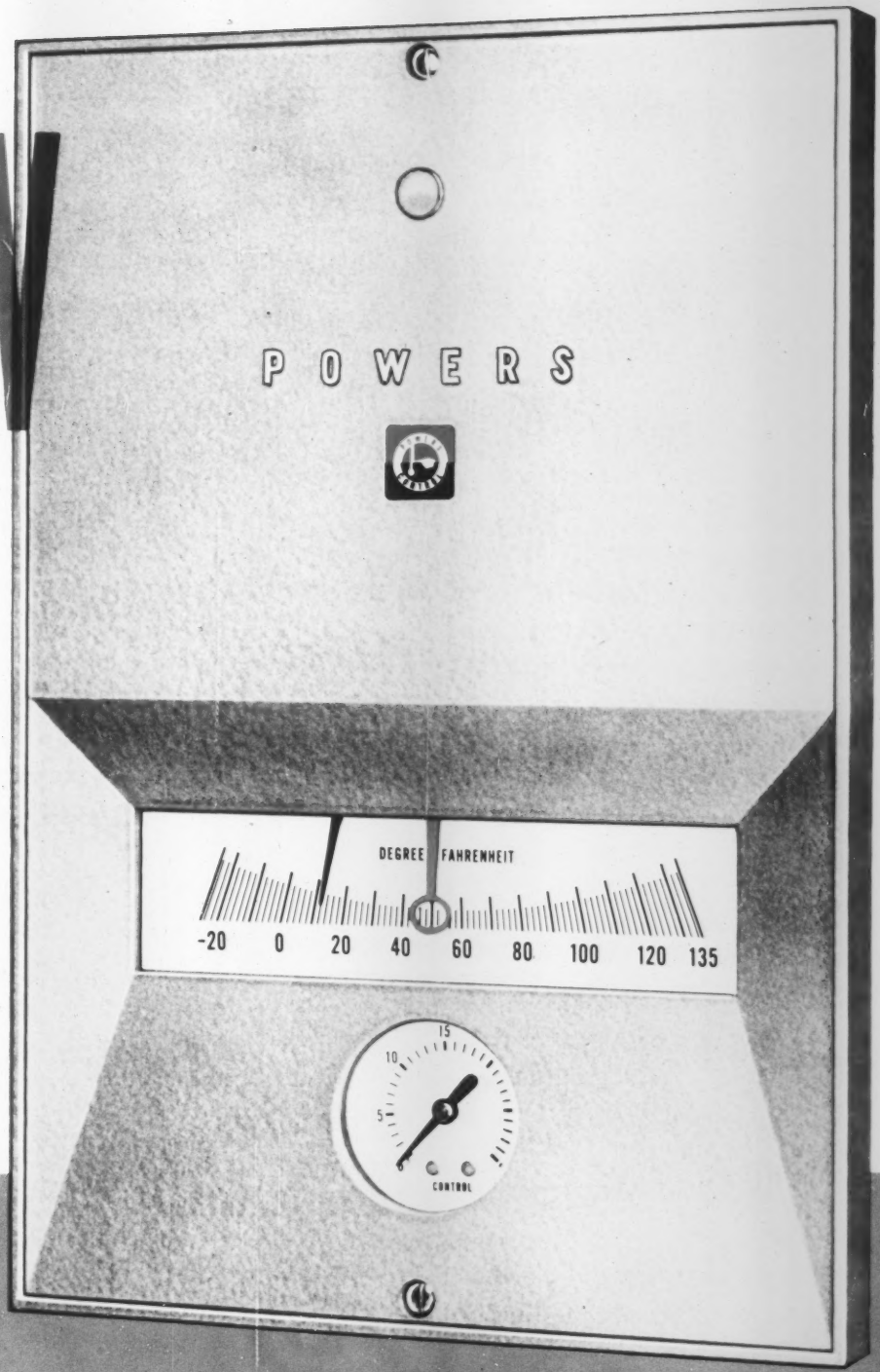
Modern baking is a highly mechanized operation—far removed from grandma's oven. In this photo, crackers pour from the delivery end of an automated travelling oven. Air-conditioning is used in large commercial bakeries today to control temperature and humidity and for employee comfort.

It gets pretty hot under a hair dryer—even *with* air-conditioning. And the girls like to enjoy having their hair done. That's why so many beauty parlors are so well air-conditioned. It benefits customers . . . employees . . . *and* owners!

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Allied Chemical

NEW



"Precise Control, Easy-to-Read Scale, Simple, Easy to Adjust, Service or Maintain. Reliable."

"Attractive Modern Design too!"

POWERS

Series 200 Instruments

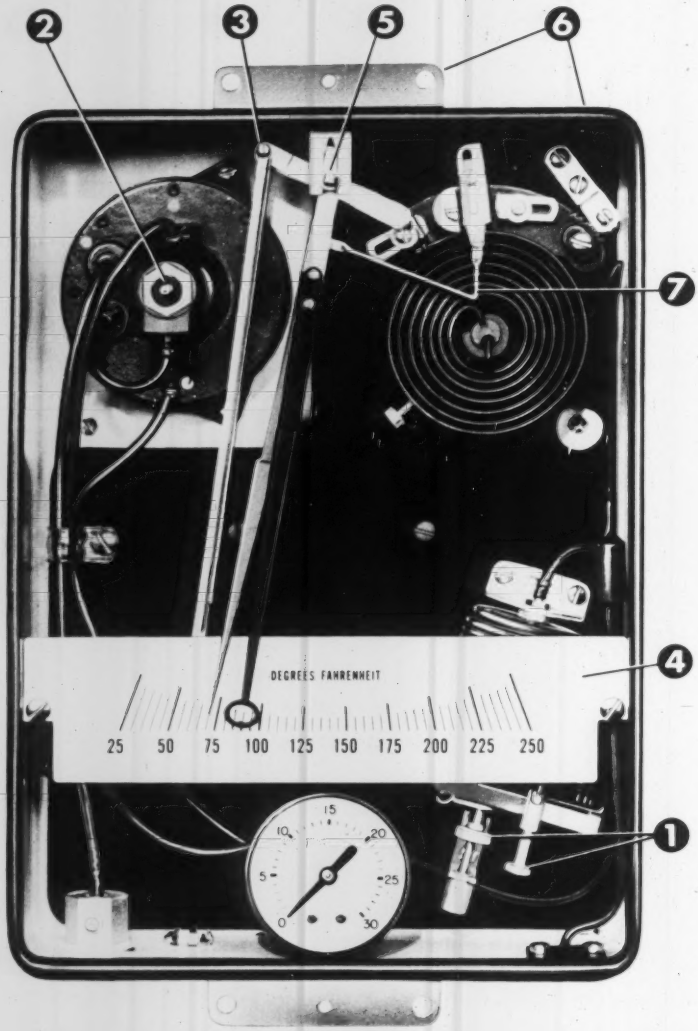
TEMPERATURE REGULATORS • SUBMASTER REGULATORS • PRESSURE REGULATORS
TRANSMITTERS & RECEIVER-CONTROLLERS • For Heating, Air Conditioning, Industrial Processes

(D17)

NOW – You Can

Check these POWERS QUALITY FEATURES

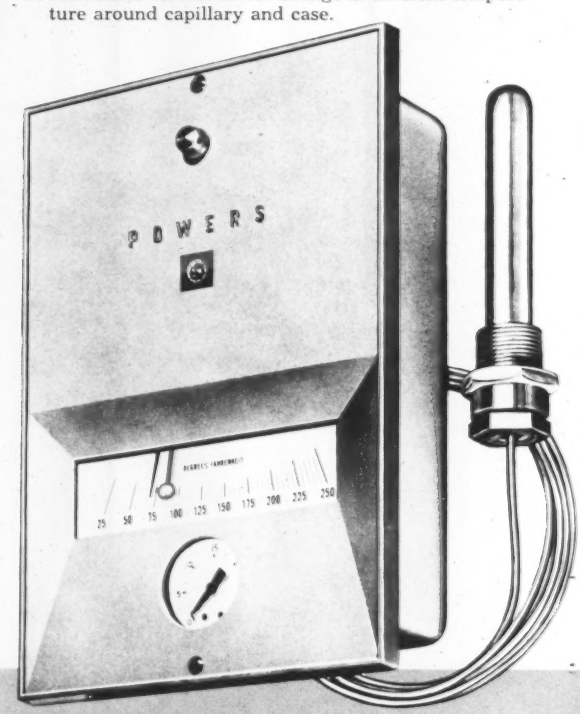
1. 0 to 35% adjustable throttling range and manual rest.
2. Ingenious new pilot valve design. Sapphire restriction and push button restriction cleaner. Cartridge filter for easy replacement. Non bleed design results in lowest air consumption.
3. Linkage design with captive screw principle. This prevents linkage connections from being jarred loose – yet permits easy reversing of linkages.
4. Large, easy-to-read-scale – a full 5⅜ inches.
5. Control point knob for concealed or external adjustment.
6. Universal mounting (flush or surface), bottom connections. Sturdy drawn metal case. Gasketed die cast cover has metallic gray enamel finish.
7. Automatic correction for change in ambient temperature around capillary and case.



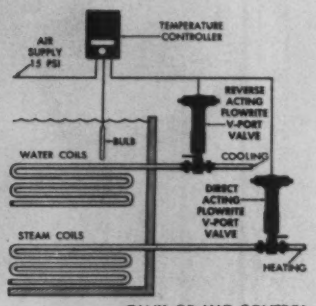
POWERS Series 200 Temperature Indicating Regulator

A pneumatic instrument designed for precise control of diaphragm valves, damper motors, Submaster Regulators and other devices used to control heating or air conditioning systems and processes. Various temperature ranges and bulb styles are available and described in Bulletin 370-1.

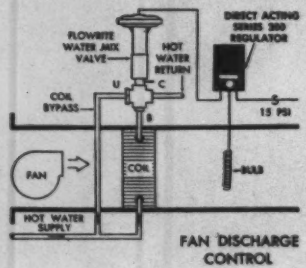
Cover Dimensions: 12¾" high x 8¾" wide x 3½" deep



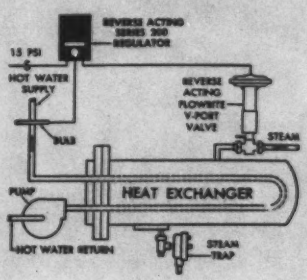
Some typical applications of Series 200 Temperature Indicating Regulators

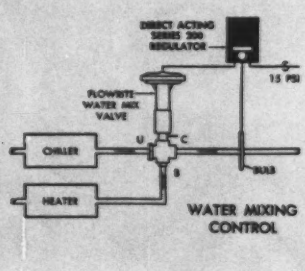


TANK OR VAT CONTROL



FAN DISCHARGE CONTROL



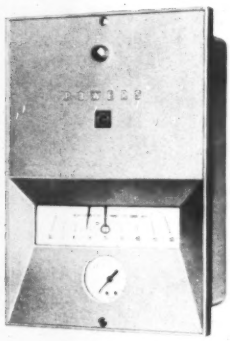


WATER MIXING CONTROL

POWERS QUALITY CONTROL SYSTEMS – "Lowest in Annual Cost of Ownership"

Specify a POWERS CONTROL SYSTEM
that will include SERIES 200 Instruments

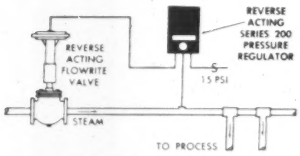
Compare their better control features that insure better performance.
They're easy to adjust, service and maintain.
Note their modern styling and simplicity.



Pressure Regulator

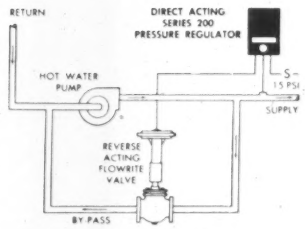
Powers Series 200 Pneumatic Control Instruments—meet the demand for precise control combined with a modern case design for mounting on centralized control panels. They were especially designed for applications in heating and air conditioning systems and industrial processes which require indicating regulators with the simplicity and time proven reliability of pneumatic control.

Series 200 Transmitter and Receiver-Controller combination provides the most accurate control obtainable where distances are too great for effective use of conventional thermal systems. The transmitter measures temperature in ducts, pipe lines or tanks and converts it into a 3 to 15 psi air pressure signal. This signal is transmitted to a remotely located pneumatic receiver-controller which indicates and maintains the temperature for which it was set, by regulating valves, dampers, sub-master regulators or other devices. Bulletin 371 gives further information about Powers transmission equipment.



PRESSURE REDUCING

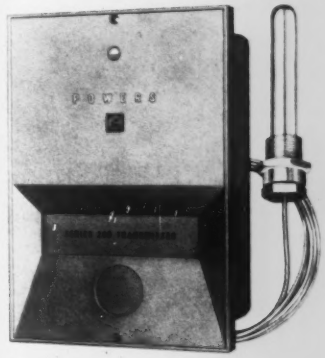
Series 200 Pressure Regulator—Wherever the precise indication and control of liquid, gas or vapor pressure is required this regulator is available in four standard ranges covering pressures between 30 inches (HG) vacuum to 350 psi. It has 0% to 35% adjustable sensitivity and manual reset. Bulletin 356 gives further information.



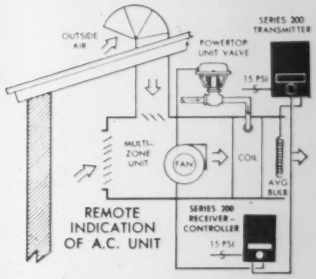
PUMP—BY-PASS CONTROL

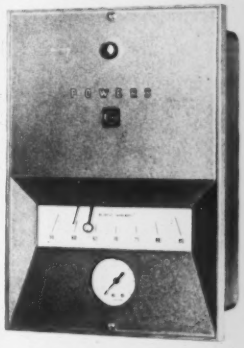
Series 200 Submaster Regulator—is a temperature indicating controller whose control point can be readjusted by a remotely located master control—a thermostat, hygrostat, pressure regulator or a manual positioning switch. See typical applications below. Bulletin 303-1 gives further information.

Call Your Nearest Powers Office for further information about these quick response, precision controls or write us direct.



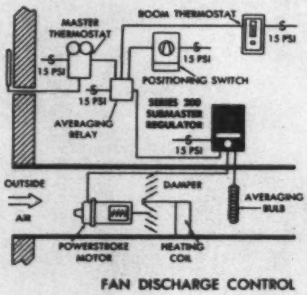
Temperature Transmitter



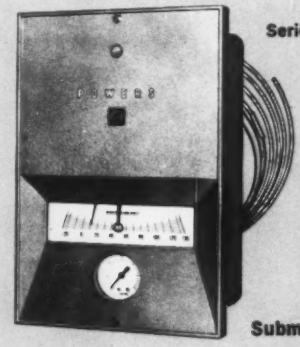


Series 200 Receiver-Controller

Some typical applications of Series 200 Submaster Temperature Regulators

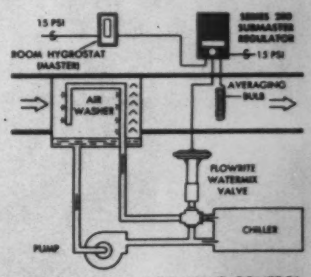


FAN DISCHARGE CONTROL



Temperature averaging bulb
Other types available.

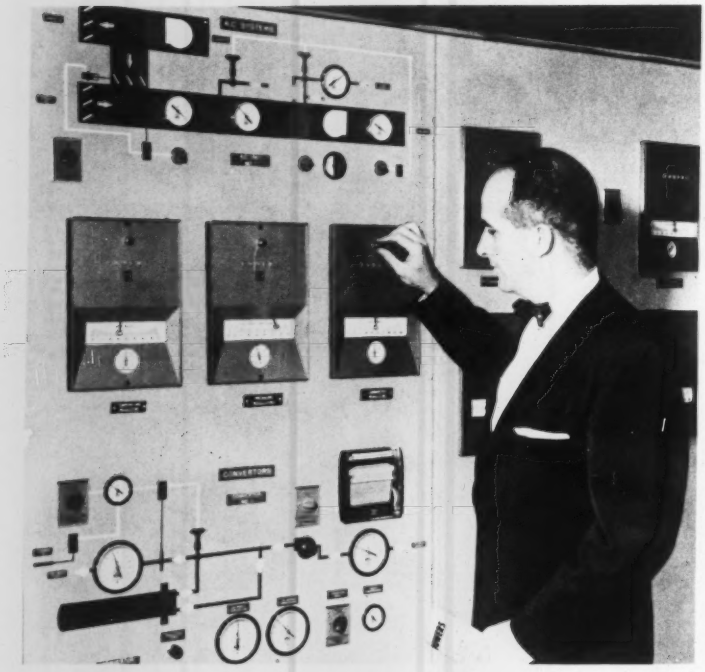
Submaster Regulator



DEW POINT CONTROL

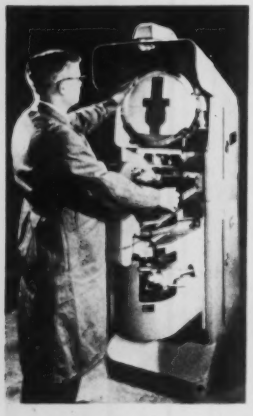
THE POWERS REGULATOR COMPANY

Skokie, Illinois • Established 1891 • SERVICE from Offices in 85 Cities in U. S. and Canada



POWERS Series 200 Instruments – are Compact, Easy to Adjust, Have Large Easy to Read Scale, and Modern Design.

They are ideally suited for control panels. Durable metallic gray enamel finish has a pleasing appearance and is easy to keep clean.



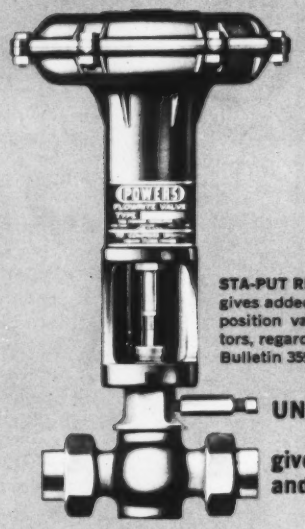
Quality Assurance at POWERS

Each control instrument is checked out and inspected step by step to assure good workmanship and precision performance.

Optical Comparator at left is only one of the many aids used in controlling the high level of precision at Powers. The silhouette of a machined part may be enlarged over 50 times for critical inspection.

Powers FLOWRITE Valves

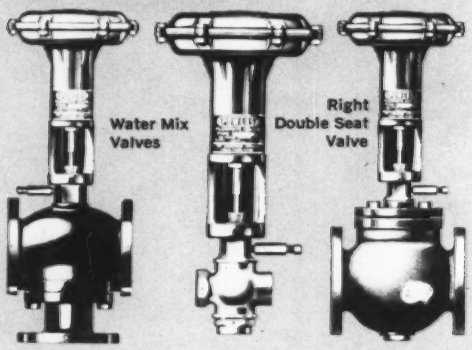
Compressed Air or Water Operated



STA-PUT RELAY valve positioner gives added power to accurately position valves or damper motors, regardless of load changes. Bulletin 359-1 describes it.

UNIQUE DESIGN FEATURES give close control and longer life

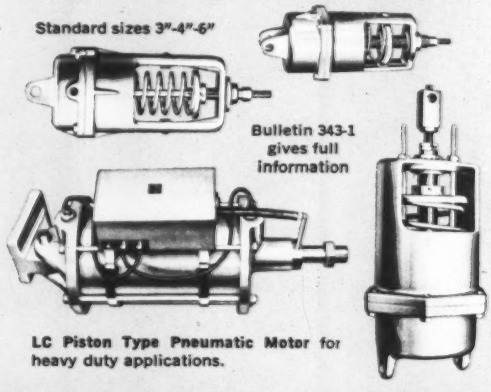
Characterized V-port Valve gives straight line flow thru-out valve travel. Renewable stainless steel poppet and separate shut off seat reduces wire drawing and insures tight shut off. Bulletin 344-V gives further information.



Powers Type 590 TEFLON Asbestos Packing, reduces maintenance, prolongs valve life—is used in all FLOWRITE Valves. Bulletins 344-S describes single seat valves, 344-DS Double seat Valves, 244-WM Water Mixing Valves.

Powers POWERSTROKE Piston Motors

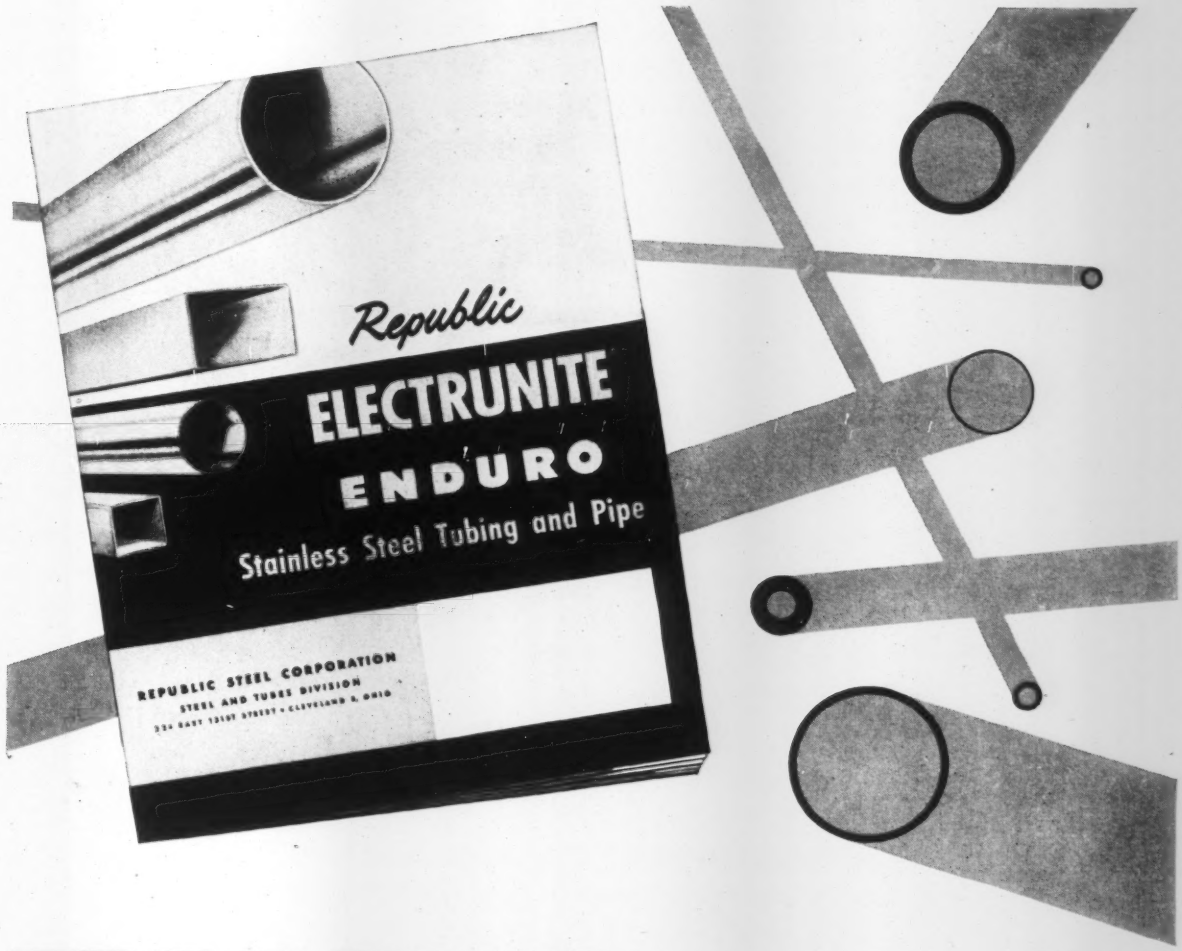
for pneumatically controlling various types and sizes of dampers and industrial operations.



LC Piston Type Pneumatic Motor for heavy duty applications.

THE POWERS REGULATOR COMPANY • Skokie Ill. • Offices in 85 Cities

PRINTED IN U.S.A.



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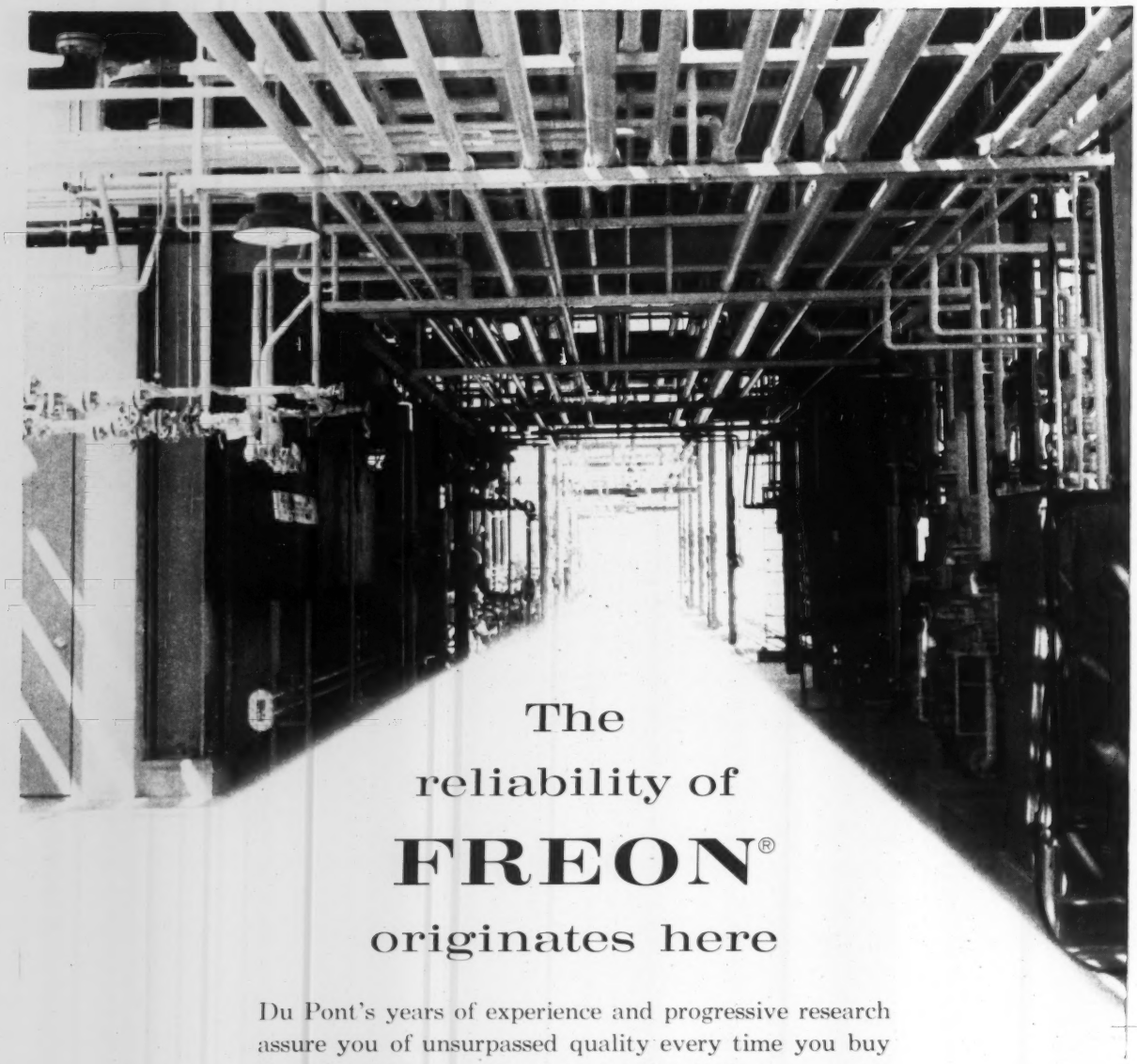


The reliability of FREON® originates here

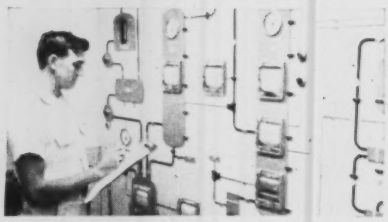
Du Pont's years of experience and progressive research assure you of unsurpassed quality every time you buy Freon* refrigerants. Factory-sealed cylinders guarantee purity. Insist on genuine "Freon" refrigerants—the gold hood cap identifies its premium quality.

DU PONT

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

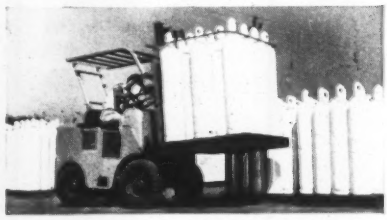
E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division, Wilmington 98, Delaware

MANUFACTURING CONTROL



LABORATORY CONTROL

UNLIMITED SUPPLY



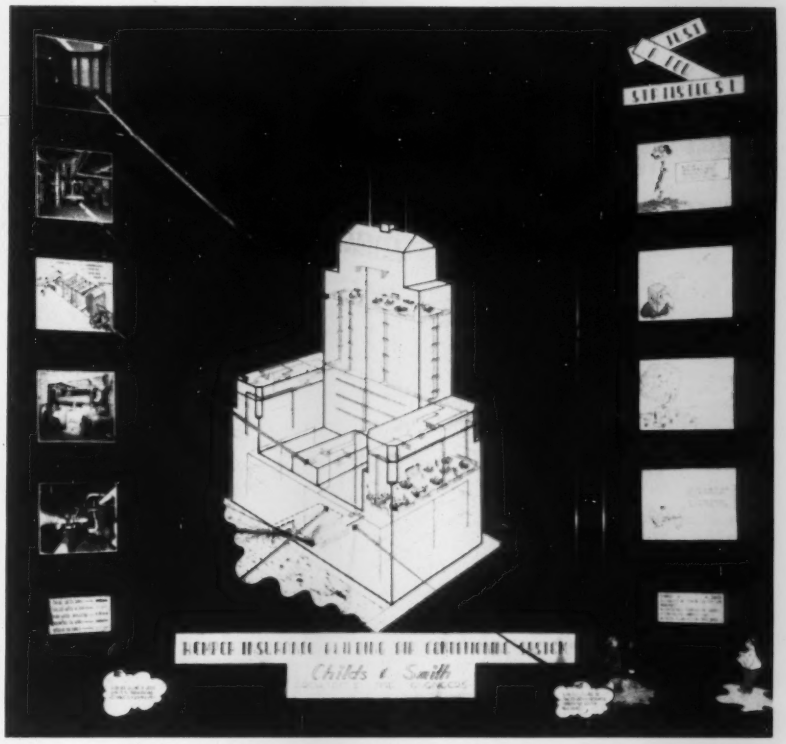
*Freon and combinations of Freon- or F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.

Heating Piping & Air Conditioning

October 1959

You'll Want To Know...

For news of new products, see the Equipment Developments department in this issue, and for new catalogs, bulletins, etc., see the Recent Trade Literature columns. Other news material also appears in the Who's What and the We Hear That departments. Meetings and Conventions are listed toward the back of this issue under that title, as are New Books and Reports.



Model Shows How Big Building Air Conditioning Works

A NOVEL and attractive three dimension model with accompanying photos and cartoons illustrates very clearly the complex air conditioning installation in the Kemper Insurance building, formerly known as the Civic Opera building, in Chicago. The model is in one of the building display windows facing the sidewalk to show how the building is now air conditioned. The building management hopes to attract prospective tenants through this display.

The air conditioning system was designed by Childs & Smith, Architects & Engineers, and the installation was completed earlier this year in time for the past hot summer cooling season.

The model shows the refrigeration compressors in the basement and explains how 8,319,000 gal of chilled

water is circulated through the system in a 10 hour normal cooling day. To condense the refrigerant and reject the heat, a total of 5,040,000 gal of water is drawn from and returned to the Chicago River in the 10 hour period. One of the cartoons shows a man suspended in the sky by balloons and the caption states that 99,130,000 cu ft of fresh air is circulated in the 10 hour period which is enough air to inflate 200,000,000 balloons.

The cooling capacity of the system is 2500 tons, and 1700 hp is required to operate the compressors, fans, and pumps. In addition to the compressors, pumps, and piping installed in the basement of the building, three large fan rooms were built on the roof and enclosed—one on the 13th floor, one on the north 23rd floor, and one on the south 23rd floor.

New Heating Methods on BRI Conference Program

NEW methods of heating buildings is one of the major parts of the program for the Building Research Institute Fall Conference on November 17-19, which will be held at the Shoreham Hotel, Washington, D. C.

Chairman of the program, John Everetts, Jr., of Charles S. Leopold Engineers, indicates that he expects this full-day session to bring out developments that will have considerable impact on buildings planned for the 1960's. New heating methods with air, water, and steam, and new types of radiant heating systems will be presented by research engineers. Also, new electric heating systems including direct resistance heating, heat pumps, and thermoelectric systems will be discussed. Progress being made in solar heating will also be reported.

Complete programs and registration material may be obtained from Harold Horowitz, Asst. Director for Technical Programs, Building Research Institute, 2101 Constitution Ave., Washington 25, D. C.

W. L. Cisler Nominated ASME President

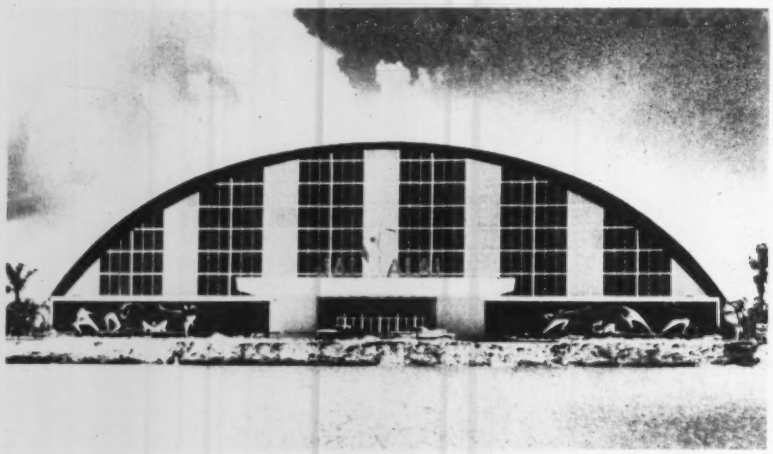
WALKER LEE CISLER, president of the Detroit Edison Company, will become national president of the American Society of Mechanical Engineers at the next annual meeting in Atlantic City, in December.

Nominated as vice presidents are: Charles H. Coogan, professor and head of the mechanical engineering department, University of Connecticut; William C. Heath, director of market development, Solar Aircraft Co.; Donald E. Marlowe, dean of the school of engineering and architecture, Catholic University of America; and Henry N. Muller, Jr., vice president of Canadian Westinghouse Co., Ltd.

Drops "Refrigeration" from Contractor's Name

REFRIGERATION SYSTEMS, INC., Chicago contractor, has changed its company name to Systems Engineering Corp. According to the announcement, the word "refrigeration" in the old name was appropriate until recent years, when "it has become a source of confusion and misconception" due to the firm's "heavy activity in the heating and piping field." The original name suggested specialization in cooling for applications in food storage and not for comfort, which has been found to be detrimental to the success of the company when working in the area of heating and air conditioning.

In reporting the name change, Systems Engineering Corp. has announced that the first contract signed under the new name has been with the Drake Hotel of Chicago. The contract is for the installation of the heating and air conditioning systems in the new $2.25 million Drake North Hotel.



Air Conditioning Popularizes "World's Fastest Sport"

AIR CONDITIONING is helping to popularize a sport new to Floridians —"jai alai." In the new 3550 seat Jai Alai Palace, recently opened in Daytona Beach, Florida, the violent activity of the game makes air conditioning imperative for both players and spectators, according to Carrier Corp.

Jai alai is similar to handball, except that wicker baskets are strapped to players' wrists for catching and throwing. The hard leather-covered ball can reach speeds of over 100 mph.

A temperature of 76 F is maintained by a system, the heart of which is a hermetic centrifugal water chilling machine of 340 tons capacity. The machine supplies cooling to 12 air handling units strategically placed around the periphery of the new building.

The same air handling equipment, when supplied with hot water, will heat the Palace for industrial displays, sports shows and other events during the winter.

Dry Compressed Air Pays Off in Big Plant

THE NORMAL DEMAND for compressed air at General Electric's Appliance Park in Louisville, Ky. is between 20,000 and 25,000 cfm. The source of compressed air has to be extremely reliable to prevent serious production interruptions, according to John Vonderheide, manager of plant engineering.

Initially, three 5000 cfm air compressors were installed with conventional inter-cooler and after-cooler equipment which maintained a final compressed air temperature of 100 F. After less than one year of operation, manufacturing complaints were received with reference to the presence of moisture in the compressed air lines. After a careful study to determine the economic difference between spot drying in the individual buildings and a central drying system, it was decided that complete central air drying offered the greatest long range potential.

A drying system utilizing two 125 ton refrigeration compressors and a condenser-chiller was installed which was designed to cool saturated air at 100 psi from 100 F to 40 F at the air flow rate of 15,000 cfm, according to Worthington Corp.

Operating experience indicated that the final compressed air temperature of 40 F was not adequate because condensation still occurred in the long main lines carried over an outside trestle between buildings. In the meantime, plant demand had also grown to a normal rate of 20,000 cfm. Two more 5000 cfm compressors were then installed. The air drying system was revised to achieve a dew point temperature of 20 F to provide the best overall efficiency. Drying equipment of the absorption type was installed in series with the existing system to meet the lower temperature required. The series system is so arranged that the refrigeration compressors decreases the air temperature from 100 F to 50 F at the 20,000 cfm capacity, and the absorption system lowers the dew point temperature to about zero F.

Mr. Vonderheide reports that after several years of excellent service, the Appliance Park air tools and air controls do not foul up as they previously did, and preventive maintenance is on a more reliable schedule.

Mr. Vonderheide has contributed articles for publication in *Heating, Piping & Air Conditioning* based upon other experiences at Appliance Park. Two such articles appeared in the December 1958 and April 1959 issues.

New Pipefitter Apprentice Instruction Manual Available

NEW INSTRUCTION MANUAL for steamfitter pipefitter apprentices, made available recently at Purdue University during the annual apprentice contest and apprentice instructor training course, is proudly shown here with Martin J. Ward, UA assistant general secretary-treasurer, left, James Schoemann, UA International Training Fund Administrator, Peter J. Davis, Chicago, chairman of the National Joint Pipefitter Apprenticeship Committee and representative of Mechanical Contractors Association of America, and Joseph P. Corcoran, UA director of apprenticeship.

Gas Sales Reach New High

GAS utility and pipeline sales for the month of June climbed to 16.2 percent above levels of a year ago. According to the American Gas Association, this increase in sales is the result of increased demands of industrial customers.

Sales for the month amounted to 5,897 million therms, compared to 5,076 million therms sold in June, 1958. Total gas sales for the year ending June 30 were 84,337 million therms, up 6.3 percent from the previous 12 month period when sales amounted to 79,323 million therms.

W. L. Bouve Named ARI Products Secretary

THE Air-Conditioning and Refrigeration Institute has appointed Warren L. Bouve to the newly-created position of secretary, ARI Products Sections. Mr. Bouve will be responsible for arranging meetings, preparing agendas, and meeting with ARI's 11 product-sections.

Construction Contracts Reach New High

CONTRACTS for future construction in the U. S. in July rose to a new all-time high for the month, according the F. W. Dodge Corp.

Non-residential contracts in July were valued at $1,190,941,000, up 11 percent over July 1958. Cumulative totals of contracts for the first seven months of 1959, with percentage changes from the corresponding period of last year are as follows: non-residential buildings at $6,895,918,000, up 5 percent; residential buildings at $10,569,533,000 up 31 percent; heavy engineering at $5,045,872,000, down 12 percent.

New Municipal Building Uses Heat Pump System

Springfield, Illinois' new Municipal Building will be the first major municipal building now under construction to use heat pumps for year-round air conditioning.

According to the York Div. of Borg-Warner Corp., the compound-compression air source heat pump system will extract heat from outside air in winter and from inside air in the summer. The system, located in a penthouse engine room will use 200 hp of electricity to run the equipment. Two identical factory assembled heat pump "packages" will operate together when maximum heating or cooling is required.

Individual areas around the building perimeter will be conditioned by fan-coil air conditioning units, allowing personal adjustments by occupants. Central multi-zone air handling units will effectively condition the building's interior.

The three-story Municipal Building contains approximately 70,000 sq ft of floor space. The structure will cost $2½ million and is scheduled for completion before the end of 1960.

Photographic Control Panel Aids Heating, Air Conditioning Operation

ANY trouble in the operation of the heating and air conditioning systems in one of the Eastman Kodak Co. office buildings in Rochester, N. Y. can be detected by a new photographic projection screen mounted in the control panel. By switching an intercommunication system in to any one of the fan rooms it may be determined if the fans are operating smoothly. The same fan system may be projected on the color screen to show the components and exact locations of the system components which aids in correcting the difficulty quickly.

Study Foreign Markets For Air Conditioning

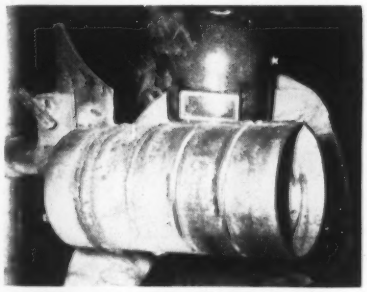
MARKET SURVEYS of air conditioning and refrigeration equipment in selected foreign countries are being conducted by the Business and Defense Services Administration of the U. S. Dept. of Commerce. These surveys include production factors, channels of distribution, consumption, imports, exports, import duties, outlook, and potentials.

Additional information concerning these surveys may be obtained from P. F. Minister, General Industrial Equipment & Components Div., Business and Defense Services Administration, U. S. Dept. of Commerce, Washington 25, D. C.

New Tug Equipped with Electric Baseboard Units

EACH of the six cabins of the new river tug, the "Captain J. G. Van Ness," of the Tidewater-Shaver Barge Lines has individually controlled electric baseboard heating units, according to Westinghouse Electric Corp. Also, the wheelhouse and galley are equipped with these units.

The electrical power aboard the tug is furnished by two 100 kw, 440 v, 3 phase, 60 cycle generators. The tug transports barges loaded with petroleum, wheat, and other bulk quantity goods between Vancouver and Pasco, Wash.



Offer New Pipe Welding Course

A NEW training course on welding pressure piping is now being offered by the Hobart Welding School, Troy, O. The course is open to trained and experienced pipe welders only.

The length of the course for the average welder is four weeks. Complete information may be obtained from the Hobart Technical School, Troy, O.

Navy Contracts for Experimental Thermolectric Air Conditioner

THE U.S. Navy has contracted for an experimental three-purpose device that combines into a single system a thermoelectric air conditioner, space heater, and refrigerator-freezer. The system will produce heat and cold with solid state materials and without moving parts, according to Westinghouse Electric Corp., who has been awarded the contract to build this largest unit yet undertaken for heating and cooling by thermoelectricity.

The design of the experimental model will be such that it lends itself to the construction of a full-scale system. The three thermoelectric components of the system will be built up of identical thermoelectric elements which can be individually removed and replaced, and can act as building blocks for a system of larger size.

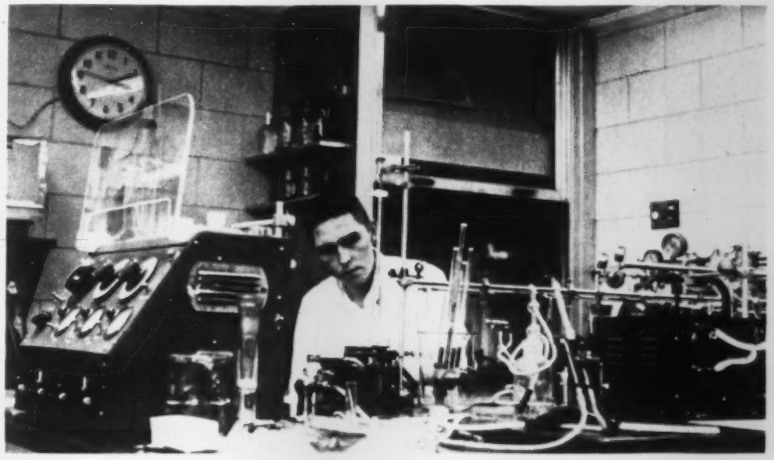
Central Control System Saves Steam, Manpower

A CENTRAL CONTROL SYSTEM in the heating plant of the East Pittsburgh works of Westinghouse Electric Corp. enables one man to "patrol and control" the entire heating system from one point. Previously, a man was required to walk a 4 hour beat.

The new control system is comprised of resistance thermometers, control relays, and motor operated steam valves located throughout the plant. A recording thermometer is also mounted on the control panel.

Steam can be shut off from any area as soon as it is no longer needed, and the entire heating system can be shut down in one minute if necessary. Also, large steam loads can be immediately diverted to aid in boiler operation when large loads are imposed by process requirements. These factors have reduced the operator maintenance time from 1730 to 115 man-days annually and have reduced yearly steam consumption from 750 to 600 million lb.

At the central control panel, individual push buttons also control relays on the fan motor starters at each central heating unit. Adjacent push buttons energize relays which control the steam valves at each unit. The two relays are interlocked so that steam cannot be turned on unless the fan motor is operating. The steam valves use slow opening devices which open the valves gradually to prevent water hammer and unequal expansion in the system.



Draft-Free Air Conditioning Vital to Lab Operation

THE work conducted in the microchemical laboratory of the Abbott Laboratories, North Chicago, Ill. is so precise that close control of the temperature, humidity, and air movement is absolutely essential, according to Elmer E. Shelberg, manager of the laboratory.

Investigation of new substances, many times with only minute quantities of the material available is one of the functions of this laboratory. With the precision instruments available, the staff is able to determine the exact amount of every element in the compound. Mr. Shelberg said one of the biggest problems in using the delicate balances and equipment is perspiration. He stated that the air conditioning system, installed when the lab was built in 1937, has eliminated this problem and has increased the efficiency. He said it was also important to note that drafts cannot be tolerated in this lab and that it is necessary to maintain a constant temperature and eliminate excessive humidity.

Low velocity air diffusers were installed as a part of the original air conditioning installation, and these have been important in assuring imperceptible air movement so essential in the development of the laboratory's own combustion units. These units are used in determining the amount of carbon, hydrogen, nitrogen, and oxygen in organic compounds.

The 40 x 20 ft lab is to be expanded in the near future, according to the Pyle-National Co.

Set Program for BRI Conference

AT ITS CONFERENCE in Washington D.C. November 17-19, the Building Research Institute reports that it will have some 50 speakers, 80 to 90 workship participants and more than 30 panel discussion members.

Among the hottest of the program topics will be "New Heating Techniques for Buildings," under chairmanship of John Everetts, Jr., Consulting Engineer.

In addition to U.S. building research experts, Canada, South Africa and Japan, among other foreign countries, will be represented.

The Building Research Institute, which is a unit of the National Academy of Sciences-National Research Council, is a private, nonprofit organization which draws it members from the building industry and related professions throughout the U.S. and many foreign countries.

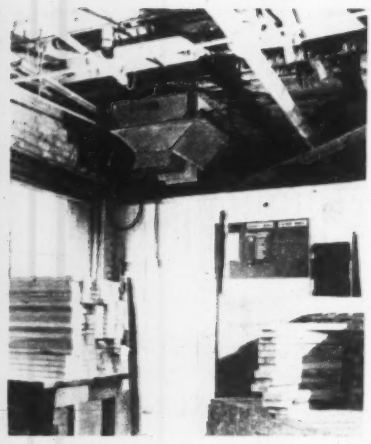
Copies of the full program and registration information for the BRI Fall Conferences may be obtained by writing to Milton C. Coon, Jr., Executive Director, Building Research Institute, 2101 Constitution Ave., Washington 25, D.C.

Refinery Solves Piping Problems

THE PORT ARTHUR, Texas refinery of Texaco, Inc., has solved two piping problems, according to Jones and Laughlin Steel Corp.

In one application, it was necessary to run a 2 in. line from a chlorinator unit 200 ft to the suction basin of the cooling tower for a naptha stabilizer. This line carries a 0.05 percent chlorine-in-water solution to "shock" treat the cooling water and prevent algae formation.

Because the chlorine solution is fed through the line only at infrequent intervals and there are no facilities to purge the line, corrosion-resistant pipe was called for. However, plastic pipe of that diameter lacks sufficient strength to span the 22 ft spaces between support trusses of an existing pipe bridge parallel to the cooling tower.



Cold Air Influx Problem Solved by Door Heaters

INSTALLATION of high velocity door heaters have solved the problem of the influx of cold air through shipping doors for the American Furniture Co. of Martinsville, Va., according to L. J. Wing Mfg. Co.

The company's Plant 2 and Plant 5 face each other across a street with heavy traffic between them requiring shipping doors in each plant to be opened frequently even in cold weather. The resulting cold air flow increased heating costs, threatened raw materials, and adversely affected employee efficiency. The problem was aggravated by dust collection system exhaust creating a negative

A heater was installed above and just in front of each 8 × 8 ft door, with its discharge 8½ ft above the floor. A fan, blowing air down over steam-heated coils, enabled each heater to produce a curtain of warm air downward to the floor.

Coil tubing is aluminum-finned copper. Coils are individually replaceable, so that damage to a coil does not necessitate replacing an entire heating section. Steam at 6 to 12 psi is supplied from the plant's low-pressure steam system.

Commonly, installations of this type are equipped so that a heater starts and stops automatically when a door opens and closes, or has thermostatic control to continue the heat after a door closes, until temperature in the door area returns to normal.

Engineers View Ice Rink Pipe System Performance

DURING CONSTRUCTION of the Central Maine Youth Center ice rink in Lewiston, Maine, the Jarvis Engineering Co., South Boston, Mass., was given an opportunity seldom afforded engineers during construction of such a rink — that of being able to observe the performance of the rink piping system during an entire winter season. In erecting an ice rink, it is customary to test the miles of pipe coils hydrostatically before they are embedded in concrete.

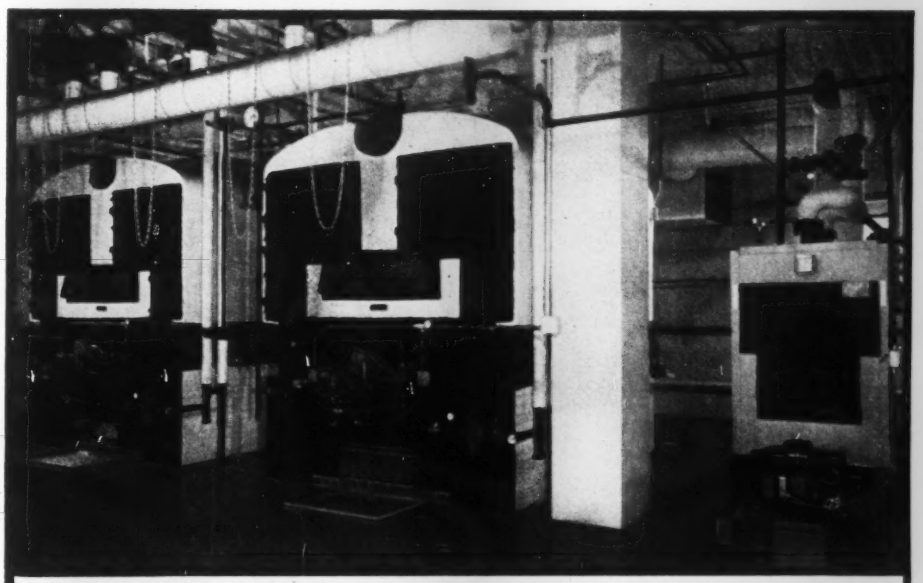
More that 10½ miles of 1¼ in. standard steel pipe was welded into hairpin coils for the system. After being tested, the coils were covered with loose sand and the 85 × 200 ft rink area was flooded and frozen.

At the close of the 1958-59 season, in April, the sand was removed to expose the 56,000 ft of brine piping. This gave the engineers an opportunity to inspect and test the system after it had been in service for the entire season. The study revealed, according to Jones & Laughlin Steel Corp., that no leaks or other defect had occurred. Welds remained sound and there was no evidence of corrosion. Brine flow was well balanced.

Central Maine Youth Center is of concrete block construction with structural steel bow-string trussess supporting the roof which has a clear span of 160 ft. The interior stadium around the rink is built of structural steel framing with steel risers and concrete slabs. The rink is designed to seat 3000.

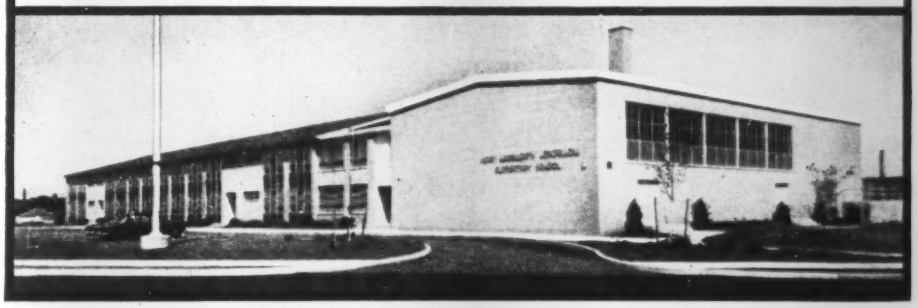
The rink piping system is positioned in a concrete slab. Each length of pipe is supported by and wired to metal chairs. This allows the 5 in. finished concrete slab to envelop the piping. Pipes are spaced on 4 in. centers.

Two H. B. Smith BIG MILLS 640, 20-Section boilers heat new Longfellow School



NEW LONGFELLOW SCHOOL IS HEATED BY TWO BIG MILLS 640 20-SECTION BOILERS — Two Big Mills 640 20-section 200 horsepower oil-fired steam boilers heat the school. H. B. Smith No. 250 6-section boiler, at right, supplies domestic hot water for all school needs.

Architect: Toby Vece, Bridgeport
Mechanical Engineers: Hill & Harrigan, New Haven
Heating Contractors: A & M Piping Contractors, Inc., Bridgeport



BRIDGEPORT CONTINUES TO SAVE MONEY WITH H. B. SMITH CAST IRON BOILERS — Bridgeport, Connecticut, has taken a long look into the future in designing and equipping the new Henry Wadsworth Longfellow Elementary School. Architect Toby Vece and Mechanical Engineers Hill and Harrigan not only designed a building of exceptional utility and appearance, but most carefully selected equipment which would provide extra years of efficient service with lowest maintenance. Thus future school department funds could be channelled to *educational* purposes rather than repairs and maintenance.

Bridgeport's Maintenance Director Albert A. Snyder's records of past boiler performance in the city schools led officials to concur wholeheartedly in the recommendations of Paul D. Harrigan, Consulting Engineer in selecting two 640-S-20 Mills boilers for this fine new building.

H.B. Smith **CAST IRON BOILERS**

THE H. B. SMITH COMPANY, INC., WESTFIELD, MASSACHUSETTS • Est. 1853

Quick selection from TACO's New LP Series gives you the Specific Centrifugal Pump you need to get Required Performance!

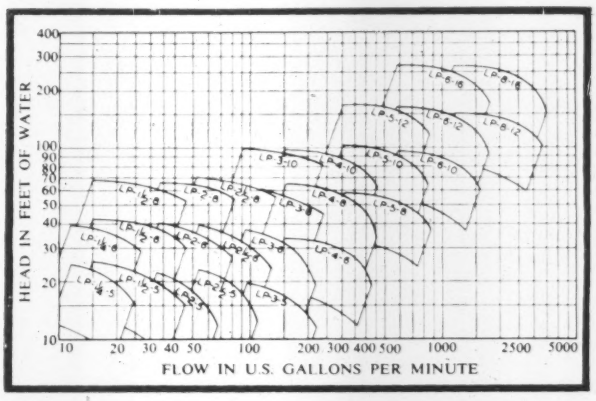
Now you can buy a centrifugal pump with almost the precise horsepower you need to get the pump performance you want! With exactness never before possible, the Taco LP centrifugal pump line design makes selection fast and easy.

For even further accuracy and economy you have these options!

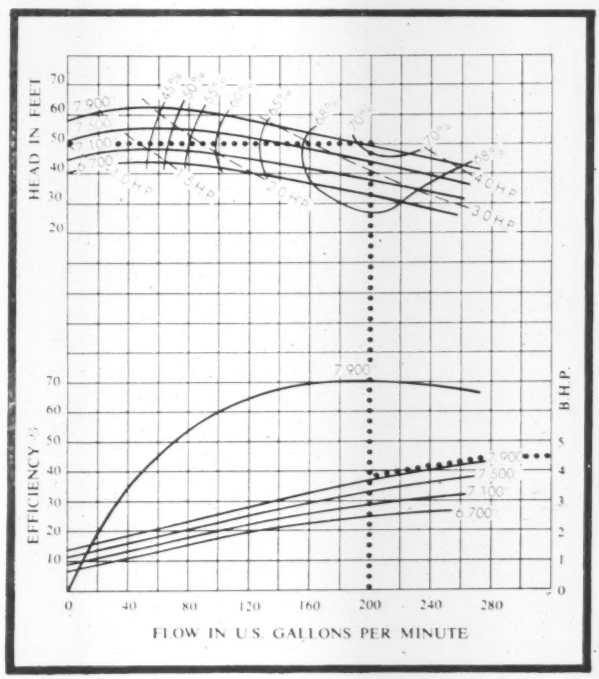
- Choose close-coupled or base-mounted models.
- Choose factory or field installation of water-cooling jackets.
- Choose sleeve or ball-bearing frames on base-mounted types.
- Choose mechanical seals or stuffing box.
- Choose the exact type of motor characteristics you want, including "extra-quiet".
- Choose stainless steel or carbon steel motor shafts, with or without stainless steel sleeves.

Fewest pump units for broadest performance range! Taco's carefully preplanned pump design has resulted in a minimum of centrifugal pump units to cover the broadest range of head and flow performances at optimum efficiencies!

Taco quick selection charts make it easy! Yes, this easy! Take a specific example where the requirement calls for pumping 200 GPM against a 50' head, with a design specification of a 1750 RPM motor. In seconds, Taco's 1750 RPM Quick Selection Chart below (3450 chart available, not illustrated) tells you that the Taco LP 3-8 is your pump.



Getting horsepower and efficiency data is just as easy! Just follow the dotted line on this LP 3-8 Performance Curve. Note that you'll need a 7.900" impeller, the BHP input is 3.7 and following the dotted line, the BHP at maximum flow is 4.4 (requiring a 5 H.P. motor) and the efficiency is 70%.



All Taco LP Pumps are tested and rated in accordance with the procedures of the Hydraulic Institute of which Taco is a member.

To cut inventory and maintenance costs LP pump parts are standardized! All LP's have ASA flanged connections; dynamically balanced impellers with double wear rings and rotatable center line discharge casings for automatic venting. Standardization of parts is welcome news to all cost conscious pump users.

New LP pump catalog, with quick selection charts available now!

You will find this new catalog to be complete, extremely helpful. In addition to quick-selection charts and performance curves, it gives complete details about Taco LP's . . . the most flexible line of centrifugal pumps ever offered hydronic engineers! Write for your copy today!

TACO

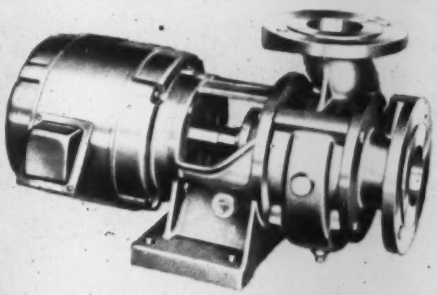
HEATERS INCORPORATED

1160 Cranston Street Cranston 9, Rhode Island

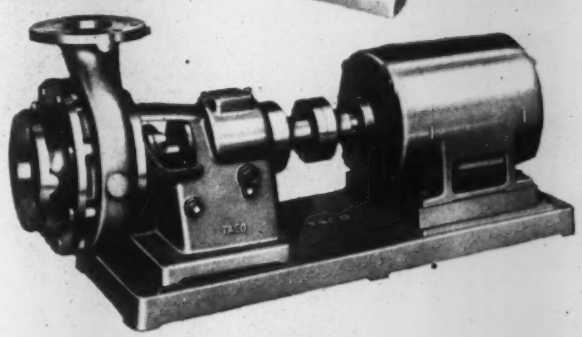
Taco®

Serving the Hydronic Industry Since 1920

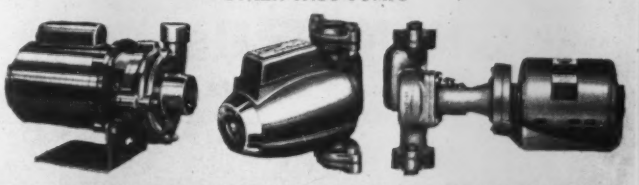
TACO "LP" SERIES CLOSE COUPLED



TACO "LP" SERIES BASE MOUNTED



OTHER TACO PUMPS



TACO 170 TACO PERFECTA PUMPS TACO CIRCULATORS

Only Grinnell has a complete line of pipe

WITH 8 . . . 9 . . . even 10 inches of thermal movement not a bit unusual in today's high temperature piping systems, complete support for piping in all positions of travel is vital.

SAFETY OF ENTIRE SYSTEM AT STAKE

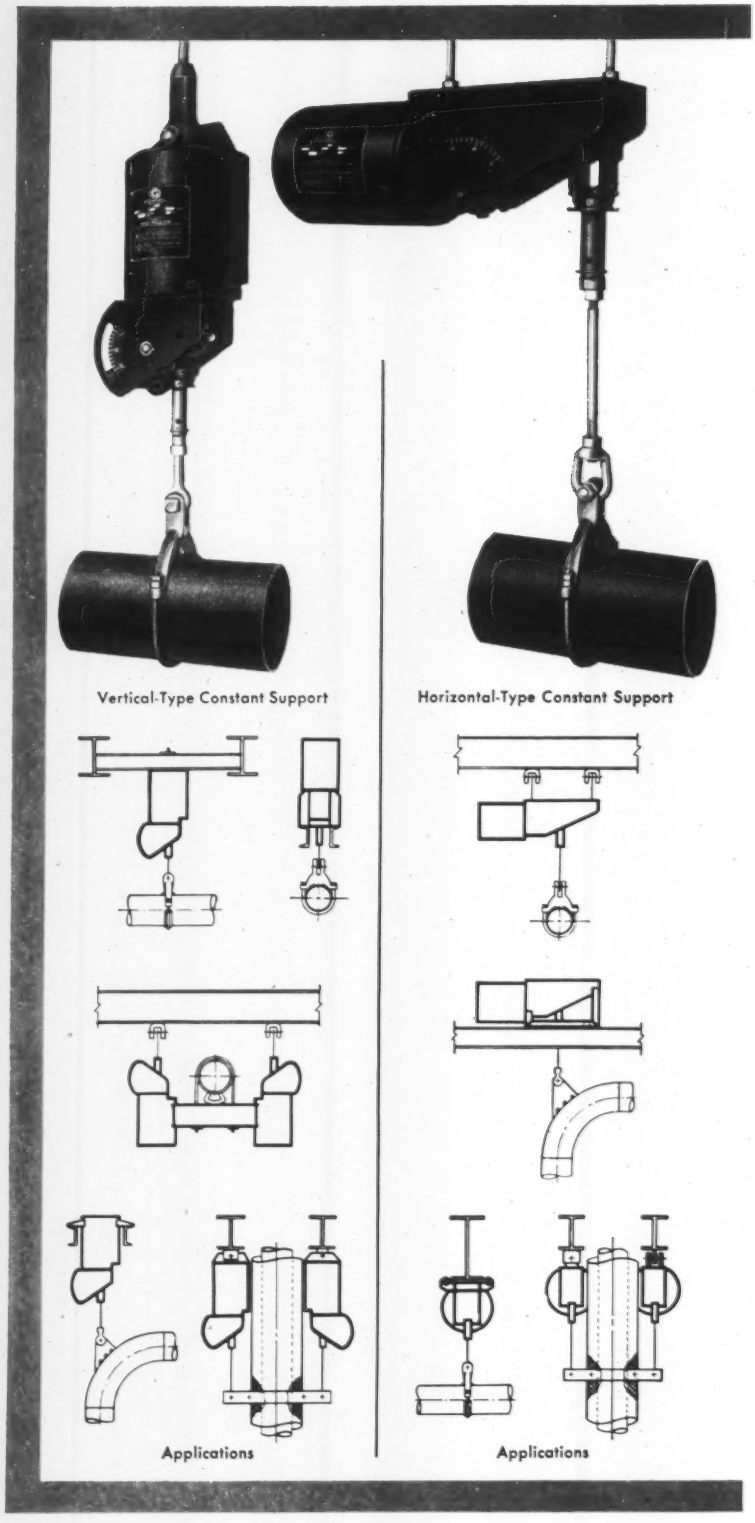
Helical coil springs are widely used to provide for thermal expansion. But the design or selection of flexible supports often is haphazard. Unless careful study is given to the design and choice of spring supports, the transfer of weight from one hanger to another, or from hanger to terminal points, can endanger the safety factor of the entire system.

MATHEMATICALLY PERFECT GRINNELL CONSTANT SUPPORTS

Grinnell Constant Supports are the result of a century of experience in the industrial piping field. A patented geometric design, exclusive with Grinnell Constant Supports, assures mathematically perfect load support throughout all positions of travel. There is also a full 70 percentage points of adjustability built into them. No less than 10 percent of this adjustability is allowed either side of calibration for plus or minus change in load. Field readjustments are easily made by turning a single load adjustment bolt. These hangers are designed to provide uniform supporting force equal to the pipe load throughout the travel range — and should be used at selected points on critical lines, as for example at turbine connections.

Available in 11 Different Types

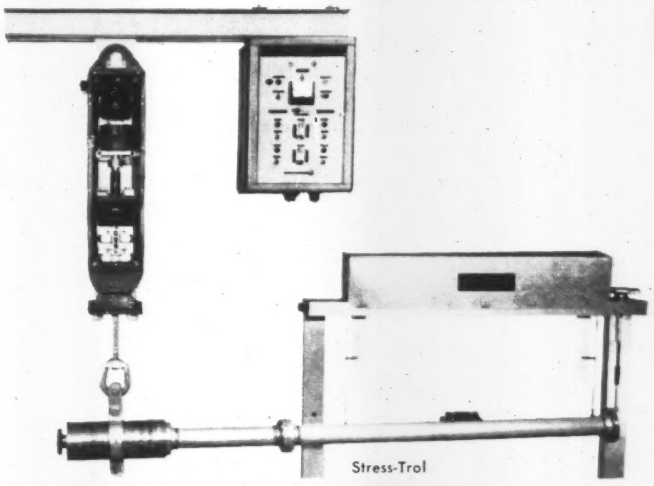
Grinnell Constant Supports are available in eleven types for a complete choice of mounting positions; above, between, or below structural steel. This choice includes both vertical and horizontal design to fit compactly into available headroom space. Even with this wide choice, Grinnell Constant Support Hangers provide mathematically perfect support through *all* ranges of travel, regardless of field adjustments.



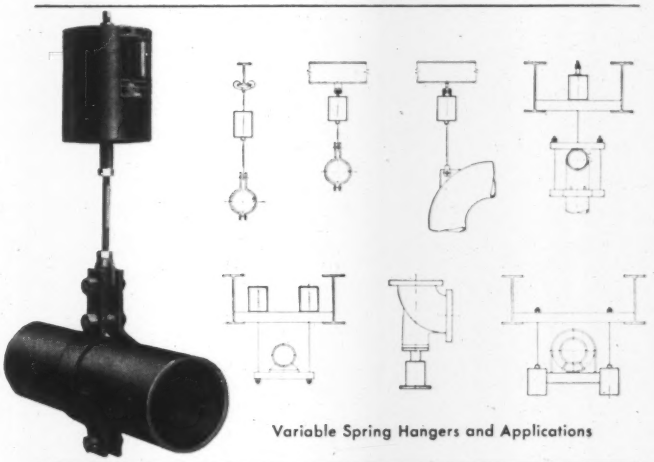
GRINNELL

AMERICA'S No. 1 SUPPLIER OF PIPE HANGERS AND SUPPLIERS

hangers to provide for thermal expansion

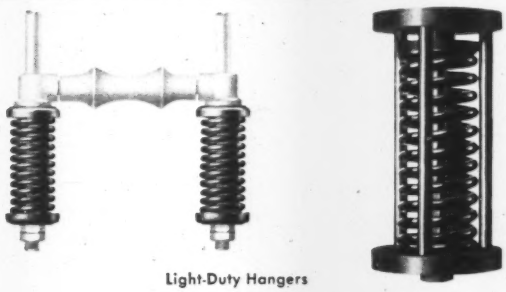


Stress-Trol



Variable Spring Hangers and Applications

Vibration Control and Sway Brace



Light-Duty Hangers

GRINNELL STRESS-TROL* FOR POSITION AND/OR LOAD CONTROL

Keeping the footage of high pressure-high temperature fabricated piping to a minimum has become important because of high piping costs. This can be accomplished by reducing the length of long expansion bends, but providing support for shorter, less flexible lengths of piping presents a new problem. Grinnell Stress-Trol, a motor operated device, solves this problem. It provides:

Position Control — that minimizes stresses in piping and reactions on connected equipment.

Load Control — that is constant support with unlimited load and travel capacities.

GRINNELL VARIABLE SPRING HANGERS

When pipe lines are subject to relatively small vertical movement, and do not require a constant support type hanger, Grinnell Variable Spring Hangers are available. The maximum variation in supporting force for standard spring models per ½ inch deflection is 10% of rated capacity. Grinnell offers these hangers in 21 sizes — in short, standard and double spring models, plus a special corrosion-resistant model. There are 7 different methods of attachment.

GRINNELL VIBRATION CONTROL AND SWAY BRACE

When necessary to prevent undesirable movement in lines, Grinnell Vibration Controls and Sway Braces of the energy storing and instant-acting counter force type are recommended. They dampen vibration, oppose pipe sway and absorb shock.

GRINNELL LIGHT-DUTY SPRING HANGERS

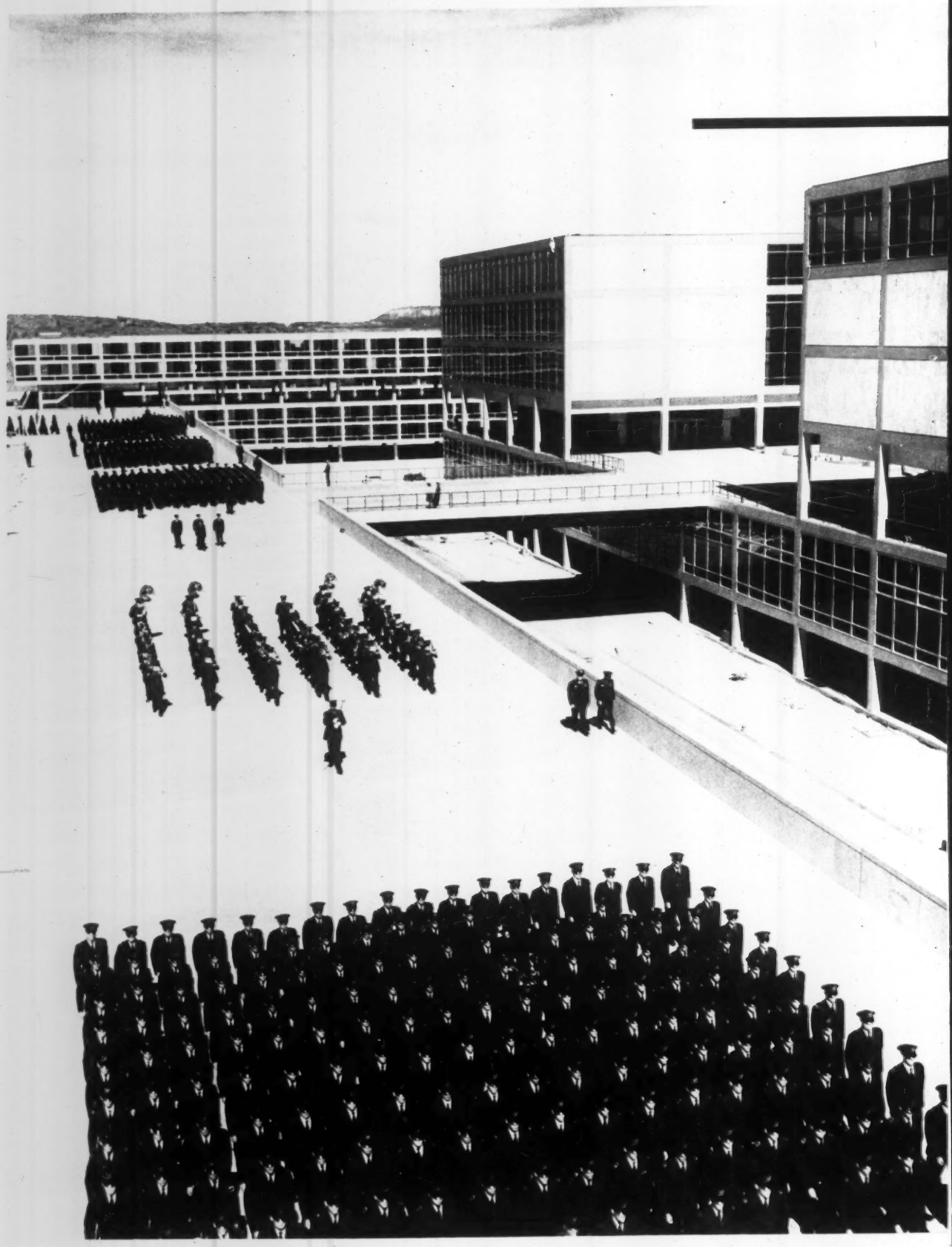
Finally, simple and inexpensive adjustable light-duty spring hangers often are all that's required to support piping safely. Grinnell has a complete line of light-duty hangers. They are designed for easy installation and quick, accurate alignment of piping.

Whatever your pipe suspension needs, Grinnell can supply them. Grinnell Company, 260 West Exchange Street, Providence 1, Rhode Island.

*Patents Applied For

GRINNELL

BRANCH WAREHOUSES AND DISTRIBUTORS IN PRINCIPAL CITIES



The new United States Air Force Academy perched at 7,200 feet above sea level near Colorado Springs and Pikes Peak.

AT THE U.S. AIR FORCE ACADEMY

GAS-operated CARRIER ABSORPTION REFRIGERATION PROVIDES TROUBLE-FREE, ECONOMICAL COOLING

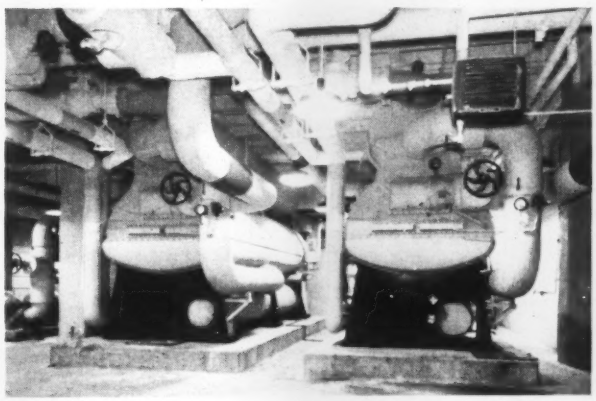
To provide comfort cooling, the new U. S. Air Force Academy is equipped with one of the most efficient, up-to-date, economical types of systems available today – gas-operated Carrier Absorption Refrigeration.

The absorption refrigeration unit makes use of one of the oldest and most reliable principles of refrigeration. No prime mover is required, only low-pressure steam or hot water. Seasonally idle or excess boiler capacity can be put to use on a year 'round basis.

This same type of automatic operation can put your heating system on a year 'round paying basis, too!

With gas as the boiler fuel, operating costs are cut to a minimum. This Carrier machine operates without noise and vibration . . . and because it is so compact and lightweight, it can be put almost anywhere – from basement to roof.

This is only part of the story of the efficiency and economy of specifying gas-operated Carrier Automatic Absorption Refrigeration equipment. Specific performance, engineering data and cost details are yours for the asking. Just call your local gas company, or write to Carrier Corporation, Syracuse 1, New York.
American Gas Association.



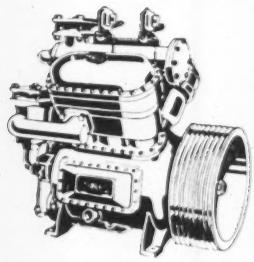
Gas-operated Carrier Automatic Absorption Refrigeration

- cuts operating expense
- lowers installation cost
- provides quiet, vibrationless operation
- answers space and weight problems
- automatically adjusts to varying loads

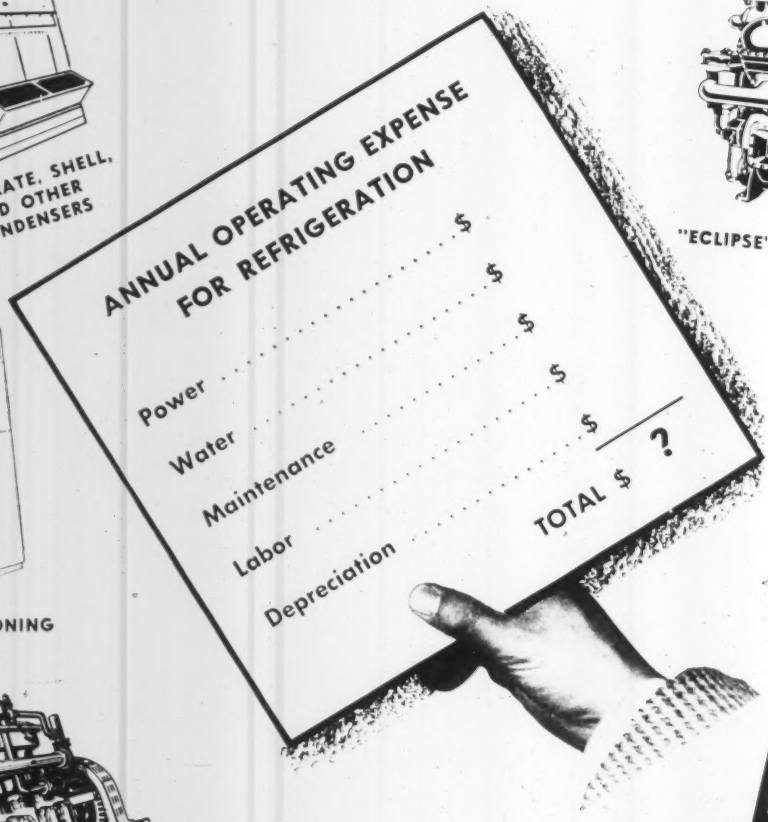
Architects: Skidmore, Owings & Merrill

DON'T OVERLOOK THIS COST SHEET!

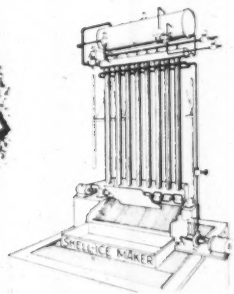
EVAPORATE, SHELL, AND OTHER CONDENSERS



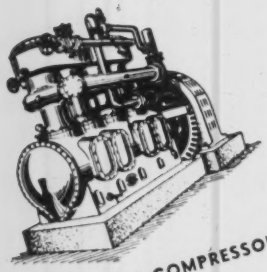
"ECLIPSE" COMPRESSORS



AIR CONDITIONING SYSTEMS



ICE-MAKING SYSTEMS



HEAVY-DUTY COMPRESSORS

ALL TYPES OF COOLING COILS

YOU CAN REDUCE MANY OF THESE COSTS!

BY HAVING THE REFRIGERATION SYSTEM DESIGNED TO MEET YOUR SPECIFIC REQUIREMENTS and by buying the entire system of equipment from a manufacturer with a background of experience and reputation in this highly specialized field.

Frick Company has been designing, manufacturing, and installing commercial and industrial refrigeration systems since 1882.

Whatever type you need—cold storage, ice making, air conditioning, quick freezing, very low temperature, or process cooling — Frick engineers will design a system to serve you with dependability and economy.

***Let* FRICK ENGINEERS Provide a Frick System for You Today.....**

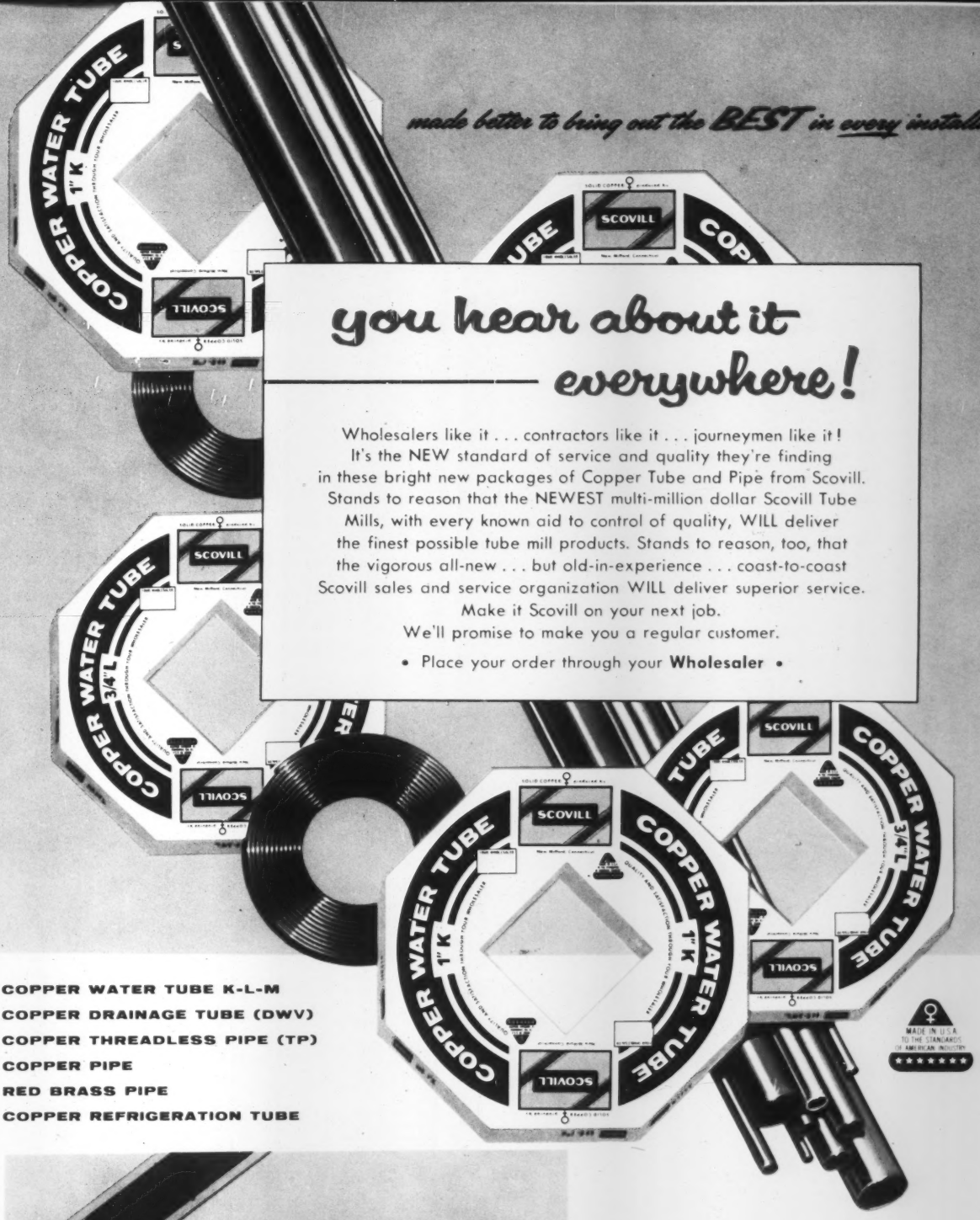
OFFICES AND DISTRIBUTORS WORLD-WIDE

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U. S. A.

made better to bring out the ***BEST*** *in every installation*



you hear about it — everywhere!

Wholesalers like it . . . contractors like it . . . journeymen like it! It's the NEW standard of service and quality they're finding in these bright new packages of Copper Tube and Pipe from Scovill. Stands to reason that the NEWEST multi-million dollar Scovill Tube Mills, with every known aid to control of quality, WILL deliver the finest possible tube mill products. Stands to reason, too, that the vigorous all-new . . . but old-in-experience . . . coast-to-coast Scovill sales and service organization WILL deliver superior service. Make it Scovill on your next job.
We'll promise to make you a regular customer.

• Place your order through your **Wholesaler** •

COPPER WATER TUBE K-L-M
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RED BRASS PIPE
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14SC59

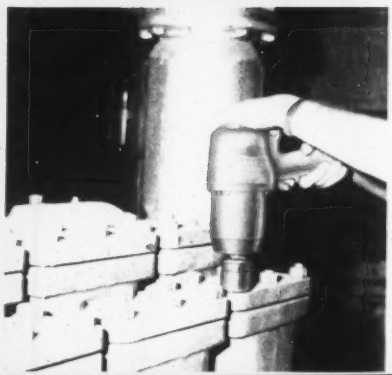
SIOUX impact offer Torque

SIOUX
Electric
IMPACT WRENCHES

Sioux electric impact wrenches offer equal power in right or left hand rotation. The torque for each wrench is stated and certified. Their mechanical design offers exactly the same advantages as that of the air wrenches. Their exclusive reverse cap switch lock prevents reversing with the current on, and eliminates burning commutator brushes and switch contacts. They are unexcelled in performance.

The SIOUX No. 318, $\frac{3}{8}$" drive, is shown removing $\frac{3}{8}$" bolts on the head of a steam condenser, part of a turbine driven, centrifugal refrigeration machine air conditioning installation. This head has to be removed once a year for cleaning the tubes.

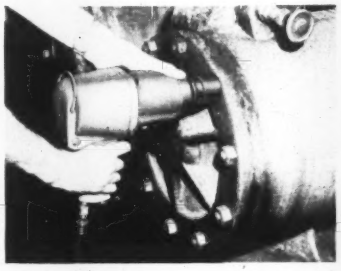
Here the SIOUX No. 322, 1" drive, is removing $\frac{7}{8}$" bolts from the head of a heat exchanger, part of an air conditioning installation which uses river water. Tubes must be cleaned monthly in the summer time in order to keep the heat transfer at efficient levels, particularly as the river water is dirty.



The SIOUX No. 322 here is removing $\frac{3}{4}$" bolts on the water end of a boiler feed pump. This is a yearly maintenance operation for reseating valves, etc.

wrenches

for every task!



This photo was taken in a boiler room and shows the SIOUX No. 322 removing 3/4" bolts from the steam end of a boiler feed pump. This must be done yearly for pulling pistons for maintenance.

CERTIFIED SIOUX POWER

SIOUX tells you the torque your air or electric impact wrench will deliver. (See specifications.) You don't buy just a wrench. You buy certified SIOUX power! Reversible power. And on air wrenches controllable power through eight point power selector.

PROVEN EFFICIENCY

Here, the advantage of the exclusive SIOUX mechanical design is revealed! You can expect your SIOUX air impact wrench to deliver *15% more torque* while *consuming 30% less air!* Less power is absorbed by the wrench itself. More is applied to the drive!

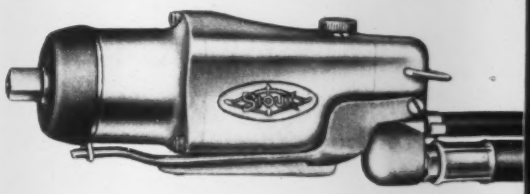
FIELD TESTED, TIME TESTED PROVEN DEPENDABILITY

The exclusive SIOUX impact wrench mechanical design has passed the toughest test of all . . . the test of time. Thousands have been giving dependable, trouble-free service for years.

REACTION BALANCED for Less Vibration Feedback

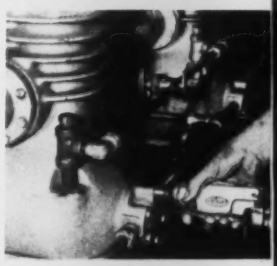
All SIOUX Impact Wrenches are "reaction balanced" for less vibration and torque feedback and for minimum operator fatigue. You can feel the difference!

ANGLE ATTACHMENT— used directly on the square of the impact wrench to reach those hard to get at spots.

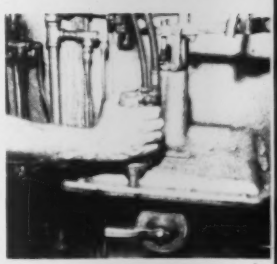


NO. 313, 314 SIOUX AIR IMPACT WRENCHES

These models feature an exclusive, remote air exhaust that carries exhausting air, and oil 6 feet from the operator, for quieter, cleaner operation. They're designed for use in restricted space, where necessary.



The SIOUX No. 313 with 3/8" wrench, 3/8" drive is being used on a boiler control to replace a diaphragm and make other repair. As these boilers furnish steam for driving turbines, that drive refrigeration machines in summer and steam for heating in winter repairs have to be made quickly.



Compare the TORQUE! the QUALITY!

Cat. No.	AIR Square Drive	Cap. Bolt Size	Torque Ft. lbs. at 90 lbs. Air Pressure at Tool
313	3/8"	3/8"	60
314	1/2"	7/16"	75
303*	1/4" Hex		
315	1/2"	5/8"	130
312*	7/16" Hex		
316	1/2"	5/8"	195
317	5/8"	5/8"	195
318	5/8"	3/4"	250
319	5/8"	7/8"	425
320	3/4"	1"	750
322	1"	1 1/8"	1000

*AIR SCREWDRIVER

Cat. No.	ELECTRIC Square Drive	Cap. Bolt Size	Torque Ft. lbs. in 10 sec. operation Right or Left
323	3/8"	7/16"	75
333	1/2"	7/16"	75
325	1/2"	5/8"	125
330	1/2"	5/8"	175
335	5/8"	5/8"	175

ALSO NO'S. 260, 262, 242, 246 ELECTRIC SCREWDRIVERS

SIOUX's the BUY!

ALBERTSON & CO., INC. SIOUX CITY IOWA, U.S.A.

AIR IMPACT WRENCHES • AIR SCREWDRIVERS • DRILLS • "PELICAN" NUT ACCUMULATORS • FLEXIBLE SHAFTS • ELECTRIC IMPACT WRENCHES • GRINDERS • SANDERS • POLISHERS • SCREWDRIVERS • PORTABLE SAWS • VALVE FACE GRINDING MACHINES • ABRASIVE DISCS

Announcing

A COMPLETE NEW LINE OF

SHAFCONAIRE

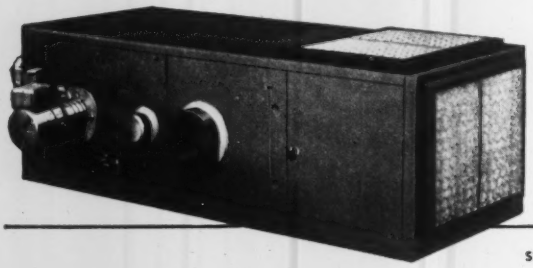
SUSPENDED *GAS FIRED* FURNACES

priced to give you a competitive advantage in the commercial and industrial heating markets!

Another "*First*" for Shafconaire! A new line of suspended gas-fired furnaces designed *right* built *right* for commercial-industrial use—and *priced right*, too, to give you profitable, volume sales! For these new Shafconaires actually cost less than any other type of gas heating equipment of equal capacity on the market today. What's more, they're covered by all required approvals for immediate installation.

4 OUTSTANDING FEATURES for Profitable Volume Sales

- **Power Burner**—provides closer control of gases through heat exchanger—gives greater heating efficiency and lower heating costs.
- **Large Capacity**—designed to handle greater volume of warm air at higher velocity—can be easily connected to duct work to provide controlled distribution of heat.
- **Maximum Head Room**—approved for installation two inches from combustible materials, compactly designed to assure greater clearance.
- **Versatility**—quickly, easily adapted in the field for right hand or left hand installation.



AVAILABLE IN 6 BASIC MODELS TO GIVE YOU BROAD MARKET COVERAGE

85,000 — 97,000 — 112,000 — 142,000 — 182,000 — 252,000 BTU Output

In addition to these six basic models, Shafconaire Gas-Fired Furnaces can also be supplied for duct heater applications. All models are furnished complete with power burner, blower, controls and with or without filters as desired.

SHAFCONAIRE—*the Specified Line for '59!* More national chain organizations have specified Shafconaire this year than ever before. So get your share of this profitable "pre-sold" volume—send coupon today for specifications and prices on the entire line of Shafconaire Suspended Furnaces.

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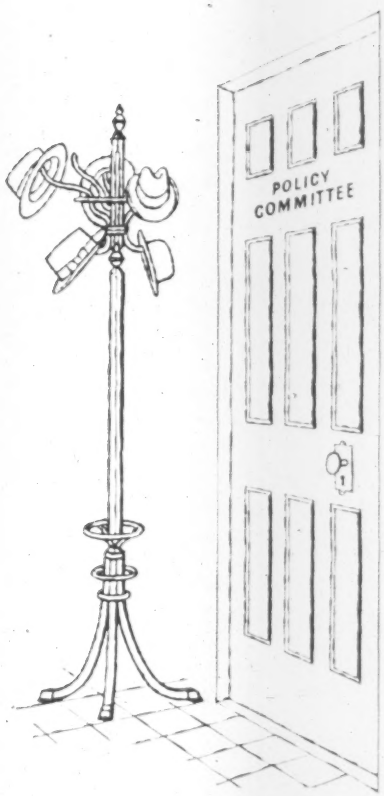
management must act



There is no doubt about it.

In recent years the responsibilities of American management have multiplied tenfold, and the areas in which decisions must be made are expanding with every passing day.

For example, just this morning our purchasing agent came to my office with a problem that, at first glance, seemed to be exclusively within his jurisdiction. Yet, as he talked and explained the situation, I could see where our policy committee was going to be forced into establishing procedure in an entirely new area. Briefly, here is the problem Jim Harkness laid in my lap. In the past several months, Jim said, various of our product managers have been requesting purchasing to buy foreign-made components to be used in the production operations carried out in their departments. These products, Jim went on, were somewhat cheaper than similar products made in the United States. Of course, the product managers were looking only at costs and were not considering such things as service and quality.

Also, Jim said, the purchasing of these imported products was presenting new problems to him as purchasing agent—problems that he sincerely felt should be answered by top management.

Problem number one, he said, showed up when one of our long-time suppliers said that if he continued to lose our business because of our purchase of a foreign-made competitive line, he had no other alternative than to shut down several machines and lay off their operators. This, Jim felt, could be the beginning of a vicious circle—the laid off men would curtail their buying and even though small at the present time, if the same thing happened to others of our suppliers, and in other segments of industry, the resulting ripples could turn into waves which would be felt throughout our entire economy. He also pointed out that, in his opinion, the purchase of imported goods had serious ramifications in other areas. The foreign manufacturer contributed absolutely nothing to the United States in return for his orders—he paid no property or corporate taxes, wasn't bothered by State levies and didn't have to pay personal income tax on his profits. As far as he could see, Jim said, the only result was that the rest of us would have to pay higher taxes all around in order to subsidize the foreign manufacturer.

Jim also declared that he felt imports damaged us in still another way. Not only do they represent the loss of domestic markets—high import figures also indicate the loss of export markets. As an example of this, he explained that U.S. brass mills formerly did a large export business. Today they have lost the export business and suffer seriously from imports. The total loss in this industry is, therefore, the loss of exports plus imports.

It was these conclusions, Jim said, that had brought him to my office. When his actions as purchasing agent began to have such far reaching consequences he felt that management should assume some of the added responsibility.

Since Jim left, I've been thinking of the things he said—and I think he's right. I'm going to recommend that our policy committee establish a buying procedure stating that we as a company will place our requirements for our United States operations with American sources in all cases where U.S. products are available. I cannot see how we can afford to do otherwise.

BOOTH NO. 1
11th EXPOSITION
AIR-CONDITIONING AND REFRIGERATION INDUSTRY
ATLANTIC CITY, N. J.
NOV. 2 to 5 1959

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If you design, specify, install or service heating equipment you will find these technical brochures on the control of draft an important aid.

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Handbook and Installation Guide

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Specification Guide

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MODEL HT
SMOKESTACK is the ONLY INDUSTRIAL STACK listed by UNDERWRITERS' LABORATORIES

When your projects call for a smokestack, you can specify a Van-Packer Model HT Prefabricated Refractory Smokestack knowing that it lives up to the high standards required to earn an Underwriters' Laboratories listing.

The Van-Packer Model HT Smokestack for boilers, furnaces, and incinerators is the *only* UL listed stack. It is the same stack for industrial applications that is already serving hundreds of users throughout the nation with these advantages: low cost, prefabricated refractory construction, maintenance-free, high draft, stocked in eight diameters nationally.

Write for new Bulletin IS-40 for complete mechanical specifications and details on Underwriters' Laboratories listing

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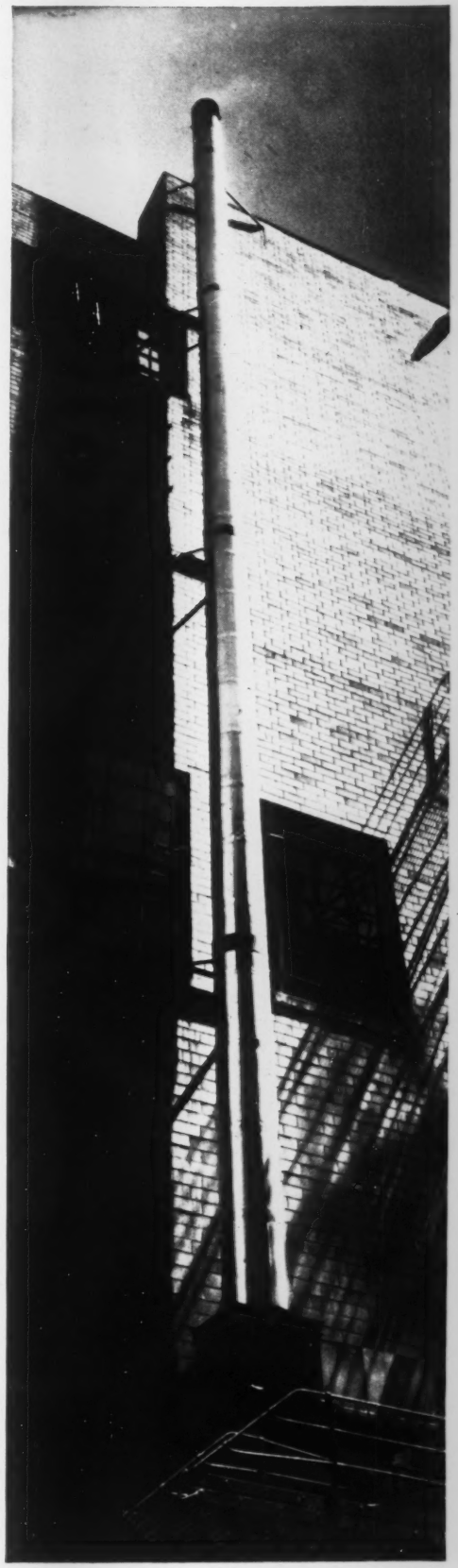

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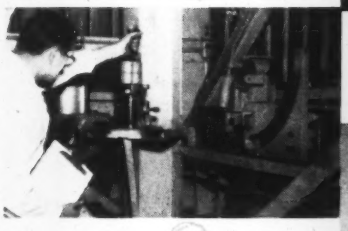

UNIFORM QUALITY
is the watchword at Nibco!

Exhaustive testing procedures and NIBCO's new automatic foundry (the only one of its kind) combine to make NIBCO red brass castings the most uniform copper tube fittings in the entire plumbing industry. To further insure uniformity, even the molding sand comes from the same pits that NIBCO has used for more than 30 years! When you want reliability, you want NIBCO . . . specified by leading architects and engineers, supplied by the nation's top wholesalers, and installed by contractors who can guarantee their work.

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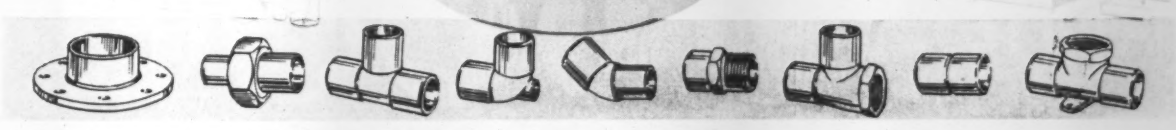
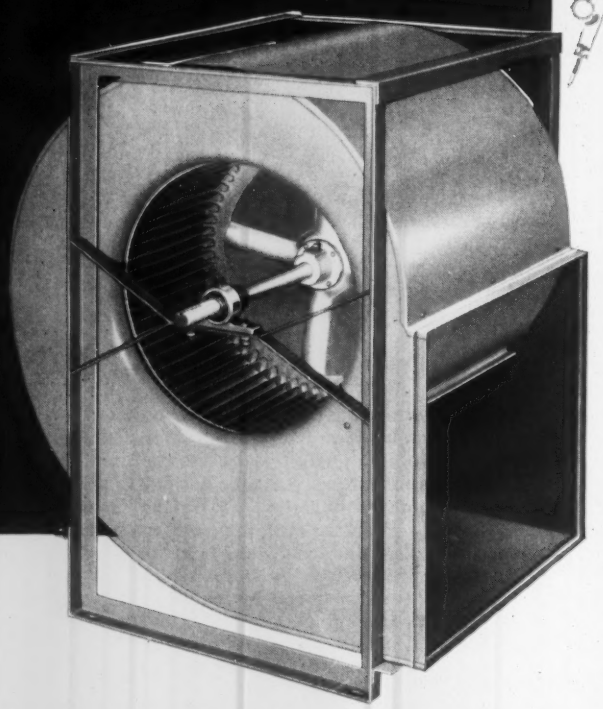


LAU

SERIES A
22", 25" and 30"

...R COMMERCIAL INSTALLATIONS



Built-in flexibility makes the Lau "Series A" the number one choice for commercial and industrial installations. With a C.F.M. range of from 8,000 to 36,000, this efficient unit may be used in many different sizes and types of air conditioning systems. For even greater C.F.M. capacity and flexibility the "Series A" may be operated in banks of two or three.

The "Series A" features such quality Lau parts as heavy gauge riveted wheels, large reservoir oil type bearings and sturdy angle framing for housing supports and structural strength. "Series A" blowers provide for either top or rear mounting motor.

Call or write Lau today for more complete and detailed information.

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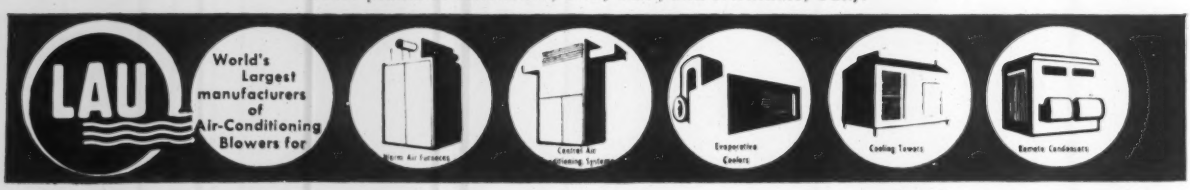
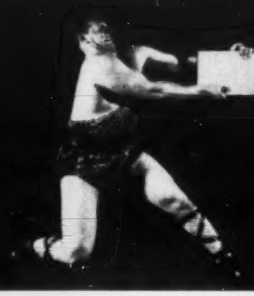
The Lau Blower Company, 2027 Home Avenue, Dayton 7, Ohio.

Other plants in Kitchener, Ont., Can., and Irwindale, Calif.

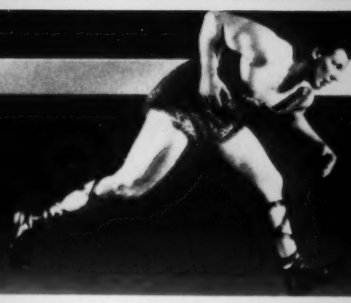




Strength

Conductivity

Pressure Resistance



Speed

All are properties of copper, bronze and brass joints assembled with Westinghouse Brazing Alloys. Cost less, too, and they are easy to use.

Yours for asking—a new 4-page bulletin which gives properties, uses, melting ranges and other data on the family of Westinghouse Phos-Copper* and Phos-Silver* brazing alloys. Write: Welding Division: Westinghouse Electric Corporation, 4454 Genesee Street, Buffalo 5, New York.

*Trade-Mark

J-22135

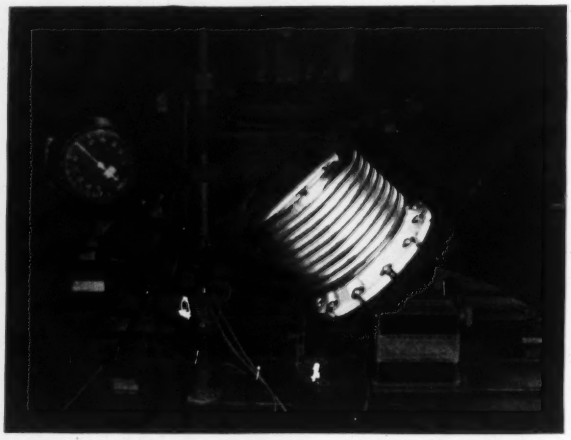
This Brazing Bulletin shows how and why

YOU CAN BE SURE...IF IT'S **Westinghouse** (W)

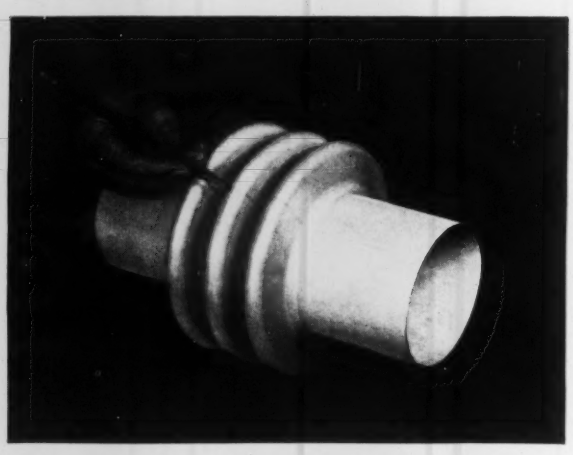
WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

4 WAYS to get maximum reliability in expansion joints

1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.



3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

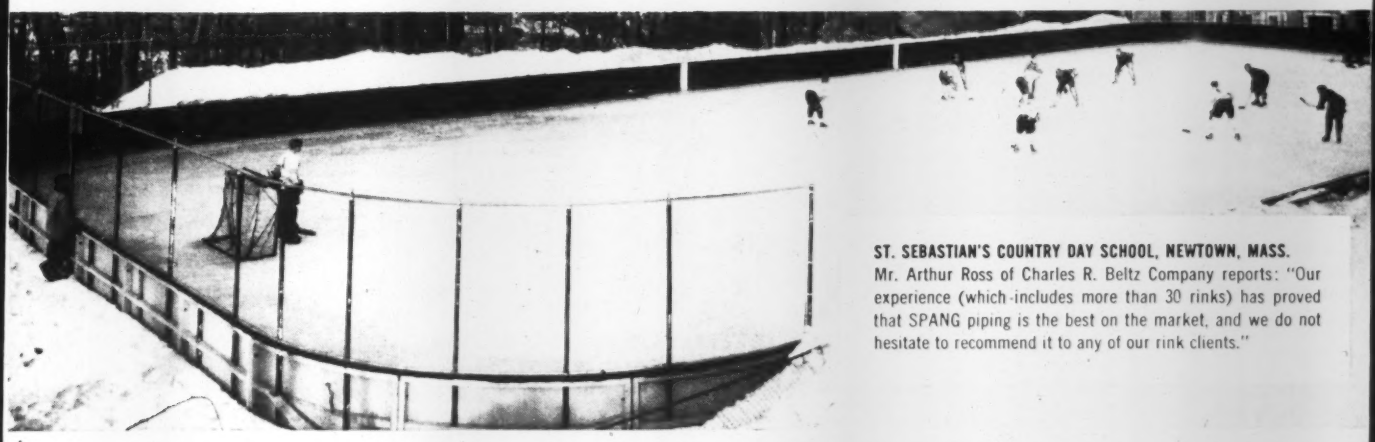
For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea *for maximum reliability*

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

THE HOTCHKISS SCHOOL, LAKEVILLE, CONN.
Mr. James Witter, Mollenberg-Betz Machine Co., states: "Because of SPANG'S rapid delivery of pipe direct to the site, the construction of this rink was a profitable job—all the way through. We also know SPANG piping requires no maintenance . . . should give us 20-30 years of trouble-free service."

CENTRAL PARK SKATING RINK, MIDLAND, MICH.
Mr. Ray Fry, City Manager, says: "SPANGRID Steel Pipe played a major role in assuring a perfect skating surface. Because the pipe is sandwiched in a layer of concrete, we had to be sure that the pipe used could withstand corrosion for the life of the rink. SPANG met these requirements."



ST. SEBASTIAN'S COUNTRY DAY SCHOOL, NEWTOWN, MASS.
Mr. Arthur Ross of Charles R. Beltz Company reports: "Our experience (which includes more than 30 rinks) has proved that SPANG piping is the best on the market, and we do not hesitate to recommend it to any of our rink clients."

You can get these advantages, too—with SPANGRID Steel Pipe. Follow the example of those who have found SPANGRID Steel Pipe ideal for skating rink installations . . . and for radiant heating and snow melting systems, too. *Quality controlled* during forming and welding, SPANGRID helps speed installations, assures *top-quality* performance. Next job, make it steel pipe . . . make it SPANGRID.

Send for your free booklet, STEEL PIPING IN ICE RINKS
This booklet has helpful information on the construction of over ninety skating rinks throughout the United States and Canada. To get your copy, mail the coupon.

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Subsidiary of Armco Steel Corporation
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THE NATIONAL SUPPLY COMPANY
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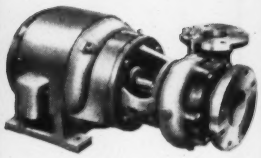

"BUFFALO" CLOSE-COUPLED PUMPS

For high-performance pumping in a limited space your best answer is a "Buffalo" Close-Coupled Single Suction Pump. Here's why:

- Easy and Economical to Install: Wide flexibility in piping and mounting are provided by adjustable discharge angle and permanently aligned shafts.
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- Wide Range of Sizes and Capacities: 1" to 6" discharge sizes. Capacities up to 1100 gpm.

The next time you need clear water pumping efficiency to fit into close quarters, ask your "Buffalo" engineering representative for full details on "Buffalo" Close-Coupled Pumps. Or write for Bulletin 975-F.

"Buffalo" pumps bring you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

"Buffalo" PUMPS

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A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Now Available! ULTRALITE® Duct Liner with special fire-resistant coating

For specification data and samples, call your G-B distributor (listed in the Yellow Pages) or write direct to:

New G-B Duct Liner conforms to strictest fire codes. ULTRALITE, Gustin-Bacon's well-known glass fiber duct liner with a 12-year record of outstanding performance, is now available at no extra cost with a gray fire-resistant coating that complies with all requirements of the National Board of Fire Underwriters' Bulletin No. 90-A and B.

The new product carries an Underwriters' Laboratories label and a flame spread classification of less than 25. It is the only liner permanently stamped with density and flame spread classification . . . the only liner made exclusively of long, strong textile-type glass fibers that impart extra strength, resilience and resistance to air erosion. Thermal and acoustical efficiency of this new gray-coated ULTRALITE, as compared with that of other duct lining materials, is outstanding. For complete information, call your nearby G-B distributor—or write today.

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Thermal and acoustical glass fiber insulations . . . molded glass fiber pipe insulation
Couplings and fittings for plain and grooved end pipe

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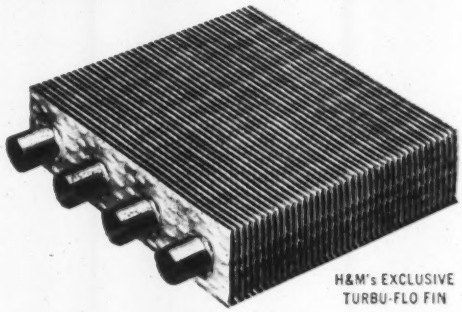
Do you need 6, 7, 8 or 10 fins per inch?

Halstead & Mitchell supplies Turbu-Flo Coils with the fin spacing you want

Why accept someone else's "standard" when your own judgment dictates another fin spacing for the specific job at hand. Now you can call on Halstead & Mitchell for Turbu-Flo coils with 6, 7, 8 or 10 fins per inch to meet your individual size requirements.

H&M makes coils for use with most refrigerants, steam (standard or non-freeze coils), hot or chilled water. All coils are available from 1 to 8 rows deep, with finned heights of 12 to 36 inches, and finned lengths up to 10 feet. Aluminum fins on seamless copper tubing are standard, though copper fins may be ordered. Casings come in heavy gauge galvanized steel or aluminum, with connections for left or right hand.

When perfect performance depends on correct design, specify H&M coils. Ask your wholesaler for complete information or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.



H&M's EXCLUSIVE TURBU-FLO FIN

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MULTI-DIRECTIONAL

AUTOMATIC GAS UNIT HEATER

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The MD is the FIRST unit heater with interchangeable and optional LOUVERS that can be installed on the job, to provide the MOST EFFECTIVE air circulation for each individual installation.

The MD is equipped with top-mounted fan, unique "open-top" heat exchanger, and completely enclosed controls. May be ducted to use 100% outside air for combustion, or installed in batteries of several units using same piping, wiring and vent.

Receive BETTER HEATING with FEWER HEATERS . . . with a HUMPHREY MD . . . available in 11 sizes, 60,000 to 270,000 btu.

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Men who know pipe point to WHEATLAND

"INSIST ON PIPE MADE IN U.S.A."

Steel pipe that lasts and lasts—Wheatland Steel Pipe—is singled out by more *knowing* men every day. They *know*, too, that the "pipe with the yearmark" is consistently superior in quality, relatively low in cost and easy-working on any application. Every length is backed by Wheatland's sincere desire for complete customer satisfaction. Next time, point to Wheatland!

...pipe with the yearmark!

For Black or Galvanized Pipe, contact your distributor or

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TO INSULATE UNDERGROUND PIPING WITH

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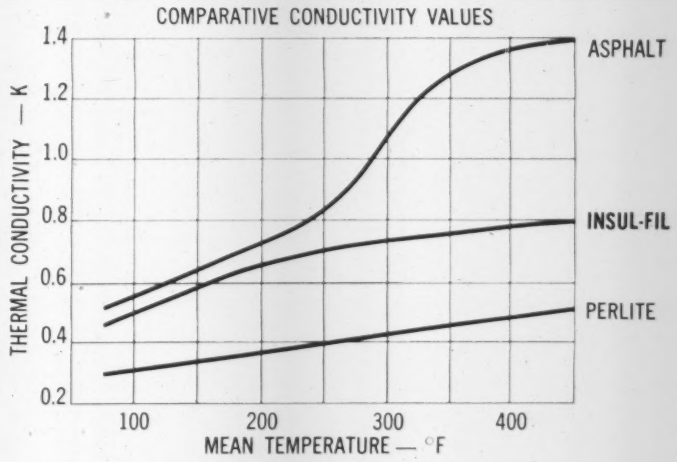
1 Introduction of a material such as expanded perlite into a granulated hard asphalt improves the insulating value of the blend.

2 Proper selection of asphalts by softening point to make up asphalt-perlite blends improves the insulating properties of the blend.

3 Introduction of an aggregate, such as perlite, into a granulated asphalt improves the mechanical properties of the blend once it is plasticized.



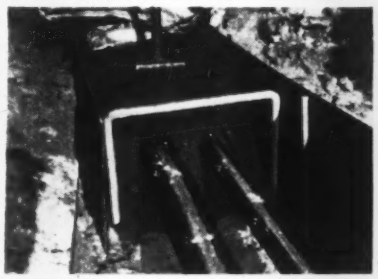
After years of extensive testing conducted at the Research and Development Department of The Atlantic Refining Company, these conclusions were presented in a Paper given before the American Chemical Society in Dallas, Texas, April, 1956. Since that time, hundreds of Insul-fil field installations have confirmed these conclusions.*

It is a well-known fact that the use of asphalt in construction created the necessity for the introduction of fillers (usually inorganic) of various types for the purpose of arresting the flow characteristics and improving the insulation value of the asphalts themselves.

The blend of hard granular asphalt and asphalt coated perlite gives Insul-fil its excellent insulating properties, water resistance and sufficient structural strength to the insulating body to resist normal soil stresses with the steam on or off.

An important Insul-fil development is the priming of the pipe with Accelerator #7591. The use of accelerator provides continuous adhesion of Insul-fil to the pipe, hastens consolidation, and gives additional protection against corrosion by galvanic action.

**Paper available on request.*



Insul-fil Is Simple To Install

Just pour it around the pipe to be insulated. Prod and tamp it in place and backfill. Heat introduced into the pipe forms the conduit.

Insul-Fil Company Inc.
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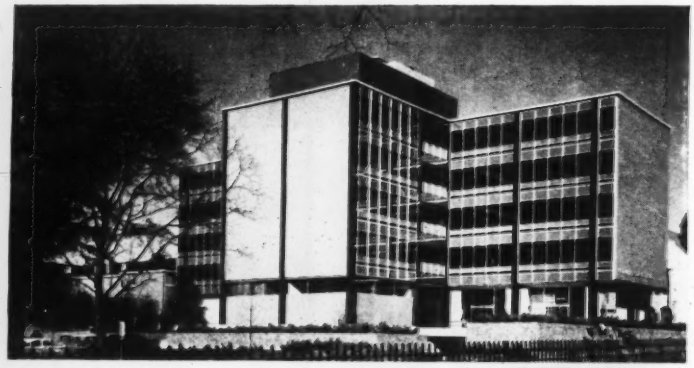
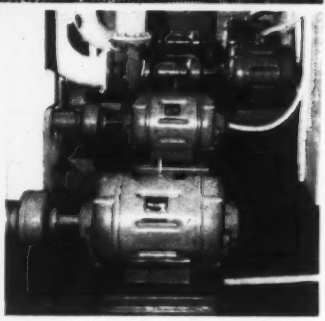
The most efficient Granular Fill Type Insulation for Hot Underground Piping

Insul-Fil Company Inc. DIVISION OF: MIRACLE ADHESIVES CORPORATION, 250 PETTIT AVENUE, BELLMORE, LONG ISLAND, N. Y.



Home Security Life Insurance Company Building, Durham, N.C., is equipped with B&G Universal Pumps. "The pumps couldn't be any quieter," says the plant engineer.



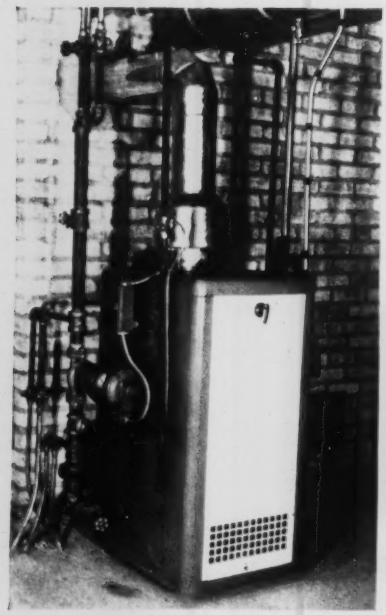
B&G BOOSTER AND UNIVERSAL PUMPS

quiet... where silence counts

Whether for residential or commercial applications of a forced hot water system, *quiet* operation of the circulating equipment is essential. A noise-creating pump can be a headache and a profit-wrecker for all concerned—architect, engineer, contractor and owner. That's why men responsible for pump selection are concentrating on B&G Boosters and Universals—for the simple reason that they will not be plagued later with noise complaints.

Since the manufacture of its first heating pump, B&G has been conscious of the need for silent, vibrationless operation. Today, B&G pumps have reached a peak of perfection—they are incredibly quiet—need no flexible connections or vibration eliminators. From B&G-built motors to B&G-developed, harder-than-glass "Remite" leak-proof seals, these pumps are *specialized* units.

B&G Boosters and Universal Pumps are available in a wide range of capacities with 1/12 to 40 H.P. motors.



The comforts of B&G Hydro-Flo Heating are obtained from a unit smaller than a refrigerator.

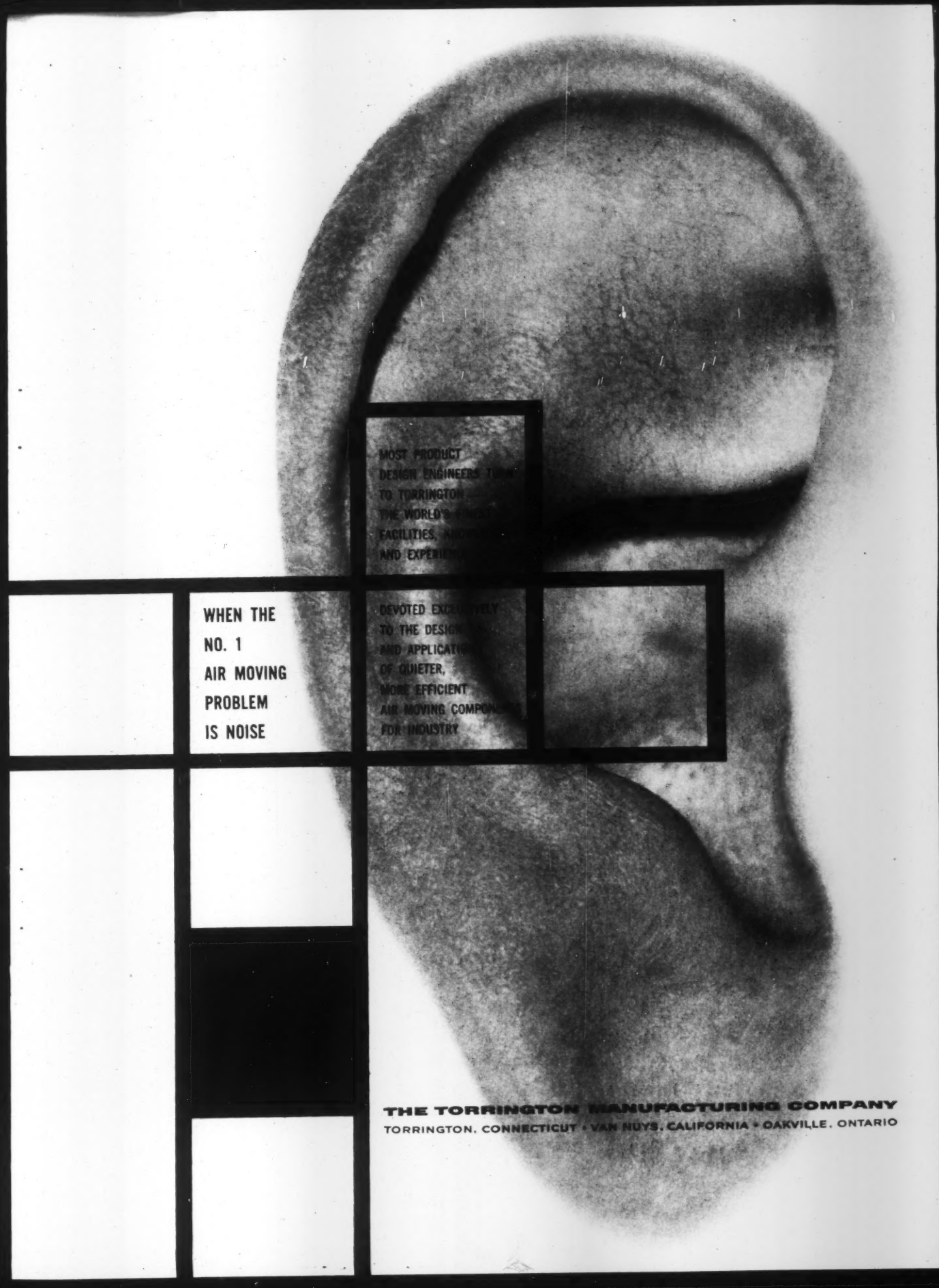
These homes have modern Hydro-Flo hot water (hydronic) heating systems equipped with B&G Booster Pumps. Builder reports that the many exclusive advantages of B&G Hydro-Flo Heating helped sell these homes fast.

Send for Catalog of B&G Hydro-Flo Products

BELL & GOSSETT COMPANY

Dept. FX-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto 16, Ontario


MOST PRODUCT
TO TORRINGTON
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AND EXPERI
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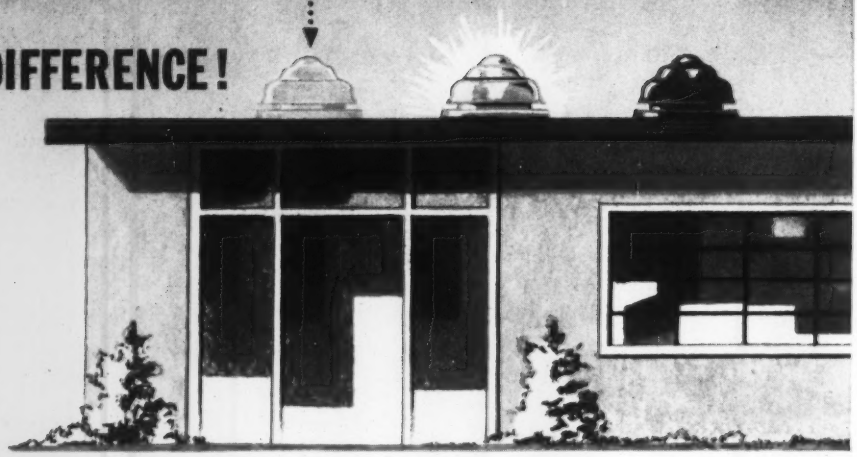
FOR INDUSTRY
THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

Color

MAKES THE DIFFERENCE!



Swartwout Fiber-Aire's Molded-In Sky-Blue Color Disappears Against The Sky

No more annoying glare of aluminum . . . no more distracting heavy appearance of dark colors. When Swartwout introduced its new Fiber-Aire units with molded-in "sky-blue" color, compliments poured in from architects, engineers, contractors and building owners praising this new color as the first ever used that prevented ventilators from marring the appearance of attractive buildings.

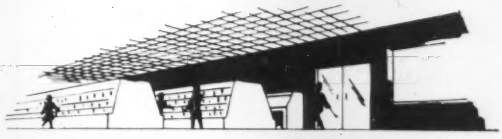
Now ALL Swartwout ventilators are available in "Sky-Blue"

While Swartwout's Fiber-Aire units have this color molded-in, other Swartwout ventilators are now available in "sky-blue" at the regular painting charge. Keep your buildings' sky lines clean . . . use Swartwout "sky-blue" ventilators.

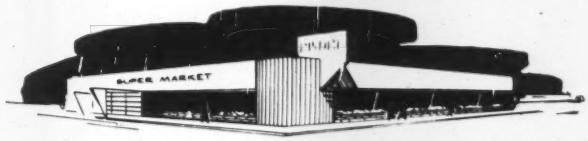
Information and prices on request.

The Swartwout Co.
Ventilation Engineering
18568 Euclid Avenue Cleveland 12, Ohio

IN CANADA:
Eastern Steel Products Ltd.
8 Bermondsey Road
Toronto, Ontario



INSTALL IT INDOORS



INSTALL IT OUTDOORS

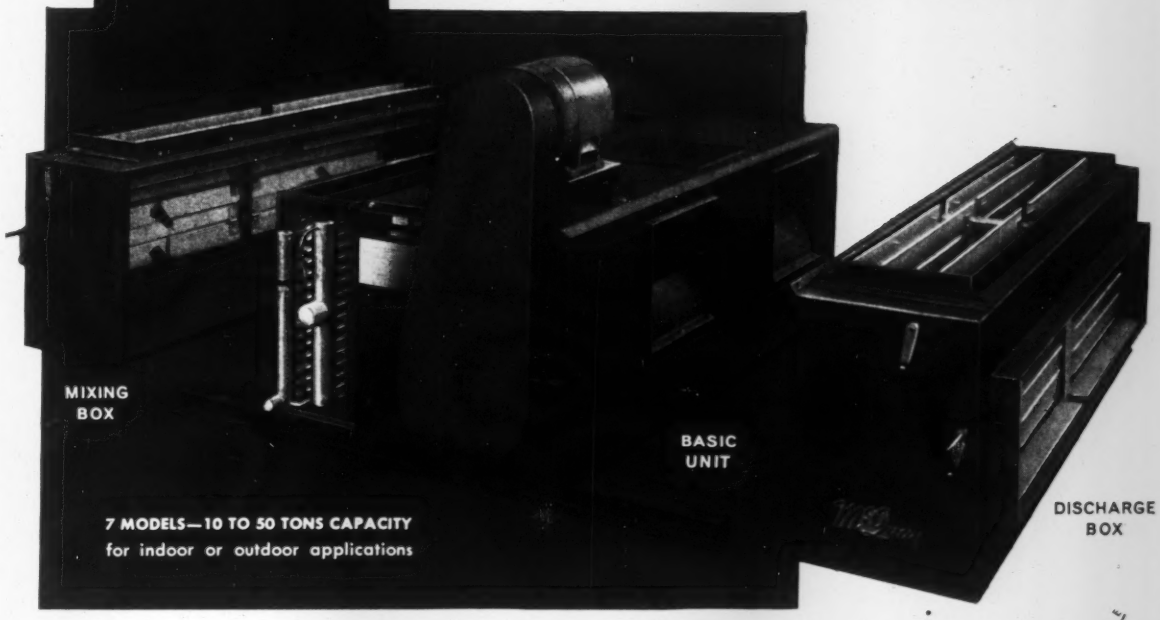
The McQuay "AL" AIRCON air cooled condenser provides the ultimate in flexibility by combining refrigerant condensing with heating and ventilating. You can utilize condenser heat for heating, and this AIRCON may also be used for exhaust ventilation, saving both time and money in installation, maintenance and operating costs.

"AL" AIRCON is compactly designed, and because of a very low silhouette, will not detract from the appearance of a building when roof mounted . . . the largest model is less than 4½ feet high, unnoticeable from the street.

"AL" AIRCON condensers are available in 8 different fan discharge arrangements and in 16 different unit arrangements . . . all standard. Each condenser coil is factory circuited in single or multiple sections to meet specific requirements of either air conditioning or refrigeration applications. Contact your nearest McQuay representative, or write McQuay, Inc., 1601 Broadway Street N. E., Minneapolis 13, Minnesota.

utilize condenser heat with this low silhouette blower type

AIR COOLED AIRCON



7 MODELS—10 TO 50 TONS CAPACITY
for indoor or outdoor applications

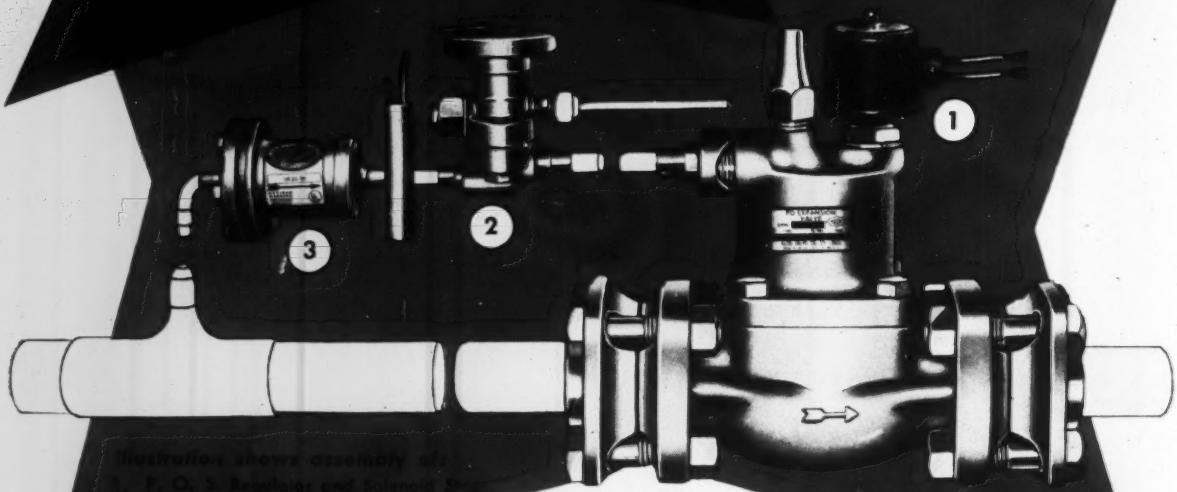
McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

New P.O.S. CHILLER CONTROL

Alco's New P. O. S. Valve is engineered with the Solenoid Pilot Stop Valve as an integral part of the P. O. Valve.



ALCO P. O. S. VALVE ASSEMBLY—designed and engineered specifically for wide load applications—particularly recommended for refrigeration systems having capacity reduction—the ALCO SOLENOID PILOT STOP VALVE insures positive liquid "Shut-off."

ALCO PILOT OPERATED THERMO EXPANSION VALVES—give a postive control to 15% of nominal capacity with minimum superheat.

ALCO LIQUID LINE STRAINERS—insure postive protection of working parts from solder and dirt.

Capacities: 20 to 200 tons

Refrigerants 12 and 22

For Specifications—
Call your Alco Wholesaler, or write

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3651 KINGSLAND AVE. • ST. LOUIS 5, MO.

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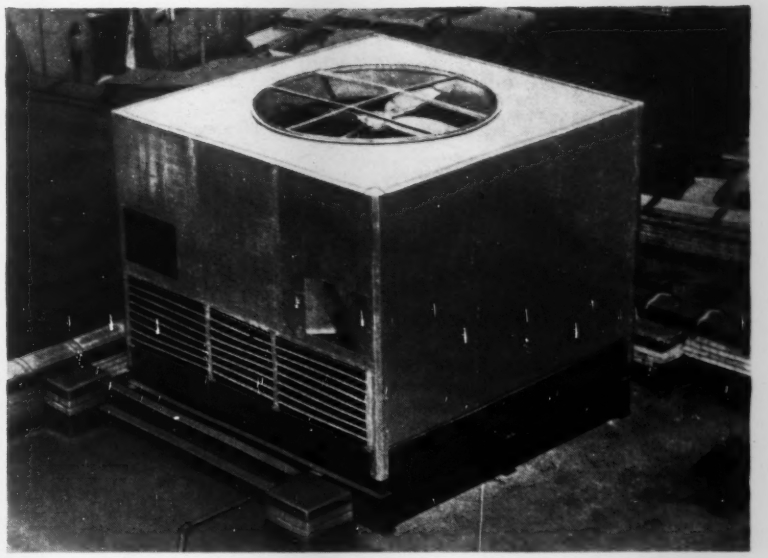
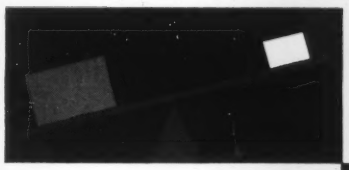
The one complete line of refrigerant controls: Thermostatic Expansion Valves • Refrigerant Distributors Solenoid Valves • Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves



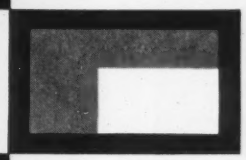
First major tower advance in years—a Carrier achievement! 9 sizes with capacity range from 170 to 500 tons in a single cell. Larger tonnages can be handled with multiple cell towers.

Carrier announces a new cooling tower

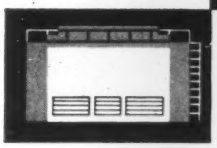
Every now and then a new product is developed that establishes a major advance in its field. The new all-steel Carrier Cooling Tower is such an innovation. So if you have the idea that a tower must be a heavy, space-eating eyesore, consider these facts:



LOWER OPERATING WEIGHT: Conventional 200-ton capacity tower, 27,000 lbs.—Carrier Tower of same size, 7500 lbs.; 400-ton tower: conventional, 56,000 lbs.—Carrier, 15,000 lbs.



LESS FLOOR AREA: Conventional 200-ton capacity tower, 240 sq. ft.—Carrier Tower of same size, 150 sq. ft.; 400-ton tower: conventional, 470 sq. ft.—Carrier, 300 sq. ft.



MORE COMPACT: New arrangement of components in Carrier Towers provides a low, smooth silhouette that lends itself to architectural treatment. No stacks, ladders or railing detract from its clean lines.

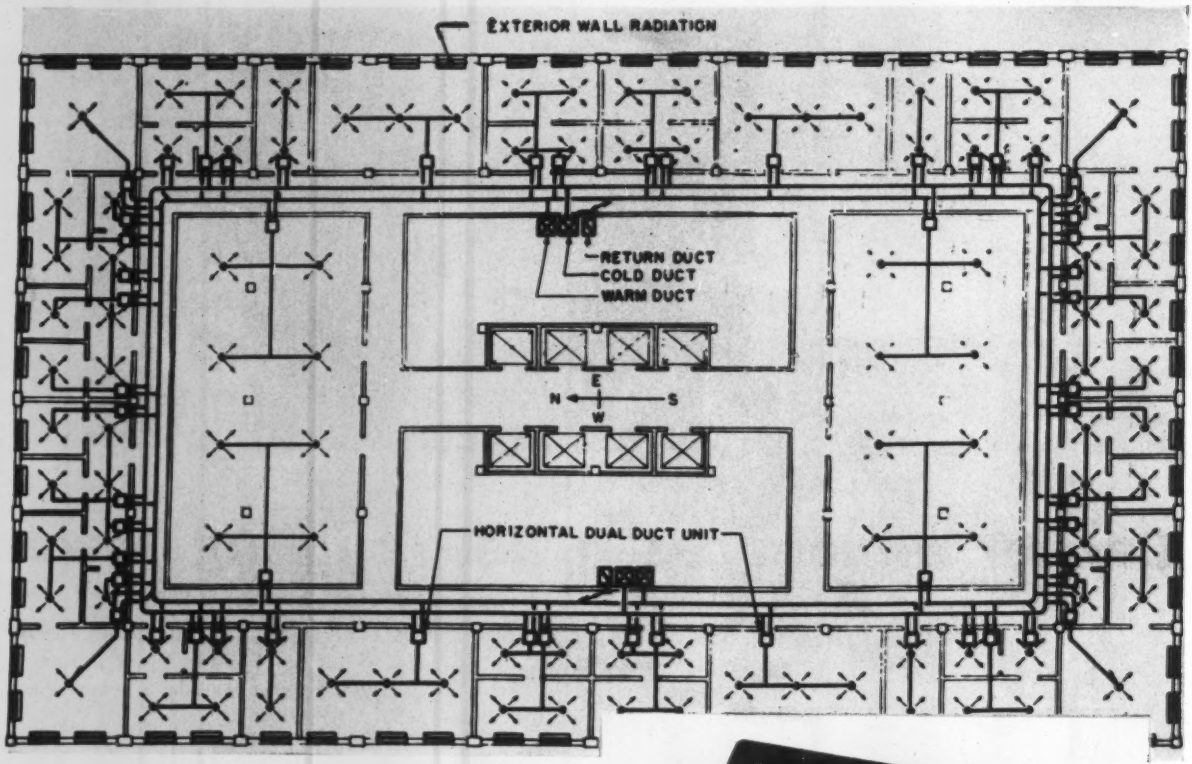
This major advance has been made possible by the use of a new kind of lightweight, plastic fortified cellulose fill, which occupies just ⅕ the space of conventional wooden strips. Tested under the most severe conditions, this fill has stood up both structurally and performance-wise.

These new towers also offer lower installation costs and operating advantages. They round out the Carrier line to enable you to specify a complete Carrier refrigeration package. For details, call the Carrier office near you. Or write Carrier Corporation, Syracuse 1, New York.

MORE PROOF OF
BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

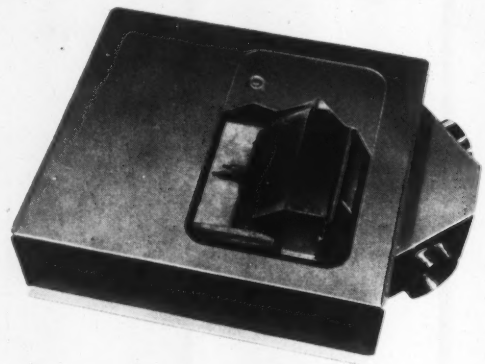
Carrier

NO BALANCING BOTTLENECK WITH BUENSOD



Shown above is a typical office building Dual Duct layout with individual overhead mixing units in each zone for selective temperature control. Radiation at the exterior walls prevents undesirable down drafts in cold climates and provides heat during night and weekend operation (existing buildings with radiation systems are usually treated in this manner). Changes in mixing units and zone arrangements may readily be made without disturbing the main system. When equipped with pre-set volume regulators, no balancing of units is required on the job site.

Illustrated: Buensod Type H unit designed for overhead installation, generally above hung ceilings. The unit discharges quietly and may be connected to any standard diffuser or grille. Cutaway shows self-contained volume regulator in place.



Tedious, on-the-job adjustment of volume used to be a major bottleneck in the installation of Dual Duct high velocity air systems. Now Buensod air mixing units with Automatic Volume Regulators eliminate that bottleneck. Units are balanced at the factory to specifications. Upon installation they will deliver the pre-determined air volume ±5%. For renovations of existing buildings, this feature permits zones to become operative upon installation of units. There is no need to wait until the entire job is complete.

A simple, tent-shaped apparatus is the heart of this Buensod unit. It automatically maintains constant air quantity, regardless of static pressure variance on mixing valve inlet or outlet. The volume control is completely independent of any sensing instrument, complicated linkage arrangement or outside power source.

Plan on Buensod for your next project.

BUENSOD DUAL-DUCT

Write for details to: BUENSOD-STACEY INCORPORATED

Buensod-Stacey, Inc., 45 West 18 Street, New York 11, New York

for dependable,
low-cost
air cleaning...

SPECIFY AIR-MAZE

FILTER PANELS

Types Available

- Dry, Washable
- Oil-Wetted
- Greastop®

ROTATING PANEL CURTAINS

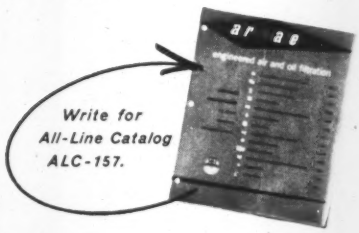
- Self-cleaning Automaze

ELECTRONIC AIR CLEANERS

- High Velocity Electromaze

Plus, a complete line of dry, oil bath and oil-wetted type air filters and air filter silencers for air intakes of air compressors and engines.

Air-Maze Corporation, Department HP-10, Cleveland 28, Ohio. (Subsidiary of ROCKWELL-STANDARD Corporation)

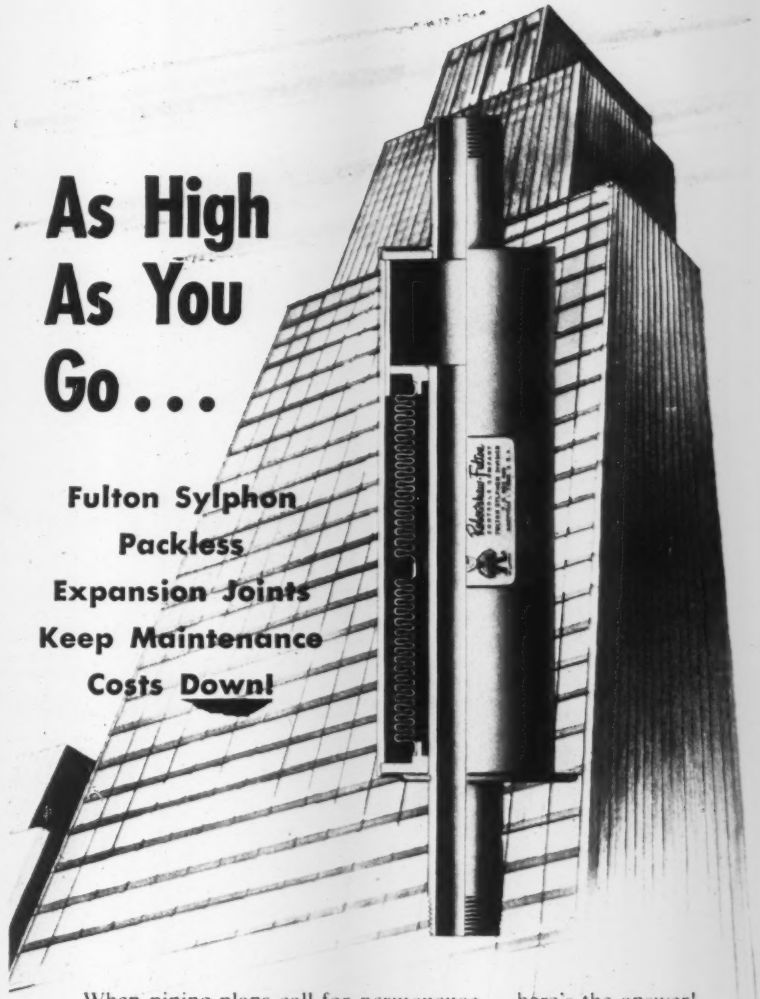


AIR-MAZE
The Filter Engineers

AIR FILTERS • SPARK ARRESTORS • LIQUID FILTERS
SILENCERS • OIL SEPARATORS • GREASE FILTERS

As High As You Go...

Fulton Sylphon Packless Expansion Joints Keep Maintenance Costs Down!



When piping plans call for *permanence* . . . here's the answer!

For vertical or horizontal pipe lines, for steam or hot water — wherever pipe movement's a problem — these packless joints provide *leak-proof movement* for lasting, trouble-free service. Annual replacement less than 2% — even after 25 years' constant use! No wasted "loop" space: no constant repacking (and repainting): these quality-engineered joints "pay their way" many times over.

All types externally shielded, internally guided. Available in ¾" to 6" sizes. Lifetime Robertshaw bellows of monel, copper or stainless steel.

For detailed information, write Dept. TH.

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any way you look at it, you see

durability

in the

MARLEY

driCooler

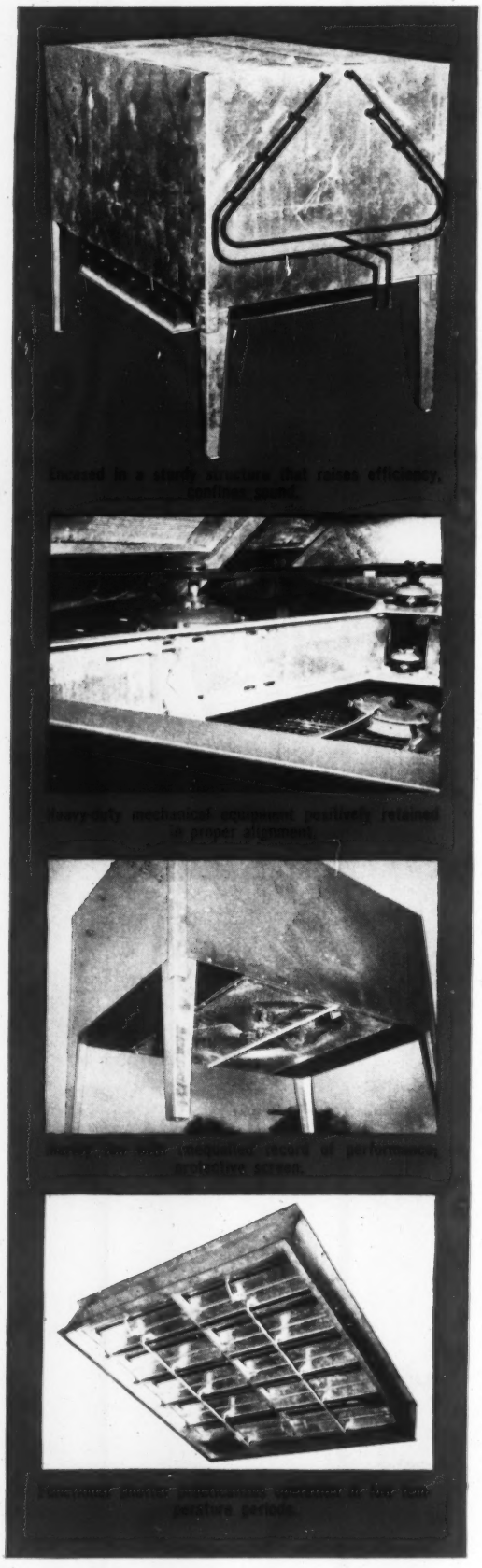
DriCooler air cooled refrigerant condensers are engineered in every detail to emphasize the three R's — rigid, rugged, reliable — that combine to produce DURABILITY. Top or bottom, inside or out, the results are completely visible.

A glance at the overall unit shows that the structure that houses mechanical equipment and coils is heavy gauge steel throughout, rigidly braced and fabricated to prevent vibration and vibratory sound. It is hot-dip galvanized after fabrication to add years of service life through ability to resist rust and corrosion.

Look through the convenient access door: you see heavy-duty, industrial type mechanical equipment supported by an X-frame of heavy steel beams. Adjustably mounted motor, V-belt drive; rugged, lubricated bearing housing and fan are retained in alignment for wearproof operation.

From below, the fan is in view. It is a plus value of every DriCooler and its ability and reliability are backed by the experience of thousands in service. Here, too, is the screen (there is another on top) that protects equipment and personnel. To this may be added the automatic shutter that maintains operating efficiency during periods of critical dry-bulb temperatures.

Any way you look at them, DriCoolers merit your careful consideration. Let us send you Bulletin DCR-59 that explains every advantageous detail, or call your local Marley Engineer in 56 major cities.



THE MARLEY COMPANY

Kansas City, Missouri

NEW "BUFFALO" AIR-COOLED CONDENSERS OFFER TROUBLE-FREE OPERATION

Troubles common to most air-cooled condensers are positively eliminated by these field-tested new "Buffalo" units.

"Buffalo" Air-Cooled Condensers are a sound engineering choice for your "problem" air conditioning installations. They are ideal for overcoming such conditions as weight and erection difficulties—high maintenance costs—winter freezing troubles—winter head pressure problems — water shortages — contaminated water — high water cost—high sewer tax—poor drainage.

"Buffalo" Air-Cooled Condensers offer these and many more advantages for air conditioning applications. For full details, call your nearby "Buffalo" engineering representative. Or write us direct.

Easy-to-Install! Shipped as factory-assembled "packages." Lifting eyebolts simplify rigging.

Trouble-Free Operation! Service calls are practically nil, thanks to quality construction and unique control design.

Capacities: 7½ to 100 tons based on 120° condensing temperature, 40° suction, 100° ambient.

Vertical Discharge is unaffected by wind velocity. Holds compressor on line.

Opposed Blade By-Pass Damper Control provides close modulating control not possible with parallel-blade dampers...or with "flooded coil control." Also saves expensive Freon.

Low Silhouette! The No. 1000 unit is only 76" high.

Unit Casings! Heavy-gauge galvanized steel construction for durable long life.

BUFFALO FORGE COMPANY Buffalo, New York

Buffalo Pumps Division, Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

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GOVERNAIR

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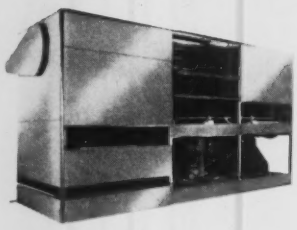


Model SCMZ

Self-contained Multi-Zone air conditioner — one of 18 basic Self Contained equipment models, available from 3 to 120 tons.

Model GMZ

Governair also "Satisfabricates" a complete line of Vertical, Horizontal and Multi-Zone Air Handling Units.

"SATISFABRICATED"©

. . . that's the copyrighted term that describes Governair air conditioning . . . equipment which is so basically flexible in design, that it can be manufactured to fit almost *any* space and load requirement.

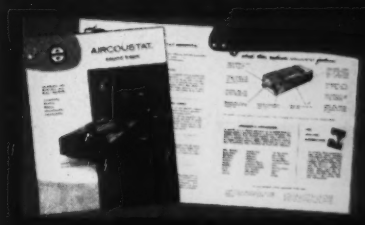
This beneficial feature, pioneered and developed by Governair, is coupled with imaginative, tested engineering and quality workmanship. The end result is an installation that's a much *wiser* dollar investment.

Write for detailed information, or consult your yellow page directory for the name of our local representative.

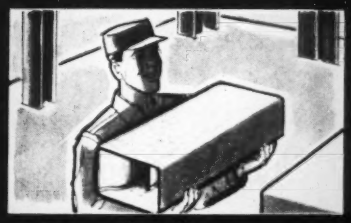
THE GOVERNAIR CORPORATION
4840 N. SEWELL • OKLAHOMA CITY

7 ways AIRCOUSTAT®
can save you time and money

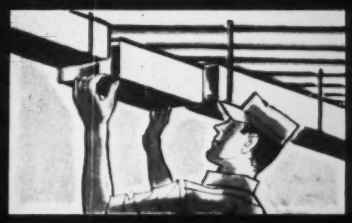
Sound Traps . . . with Guaranteed Results



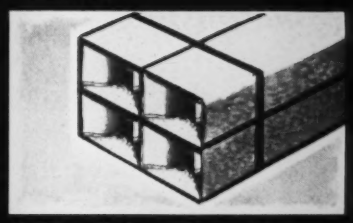
1) Easy to select—Just 3 steps to specify proper model. Save time, avoid errors.



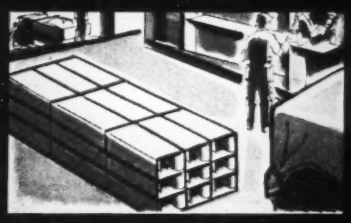
2) Easy to handle—No riggers or special equipment needed. Large units composed at job site.



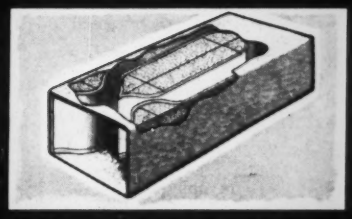
3) Easy to install—Units are installed the same as ductwork. Units have 2" extensions.



4) Fits all duct sizes—Big units are easily assembled from small Aircoustat units.



5) No storage problem—Units are delivered right to the job site, ready to install.



6) No maintenance—Units are fire-resistant, dust-proof and built to last a lifetime.

7) Guaranteed results—Solves every noise reduction problem. Units are completely reliable.

Pre-engineered by Koppers to eliminate guesswork, unnecessary calculations and difficult installations, AIRCOUSTAT Sound Traps guarantee trouble-free silencing of all duct-transmitted noise . . . at a savings in time and money to you.

AIRCOUSTAT selection is quick, simple and reliable. A choice of over 60 stock models, fabricated in 6 lengths, solves every noise reduction problem. AIRCOUSTAT is built to give a lifetime of maintenance-free service.

Write today for your copy of the AIRCOUSTAT Selection Manual, a quick guide to the right unit or combination of AIRCOUSTAT units to eliminate duct-transmitted noise in all air handling systems. Write KOPPERS COMPANY, INC., Sound Control Department, 3410 Scott Street, Baltimore 3, Maryland.

KOPPERS®

SOUND CONTROL

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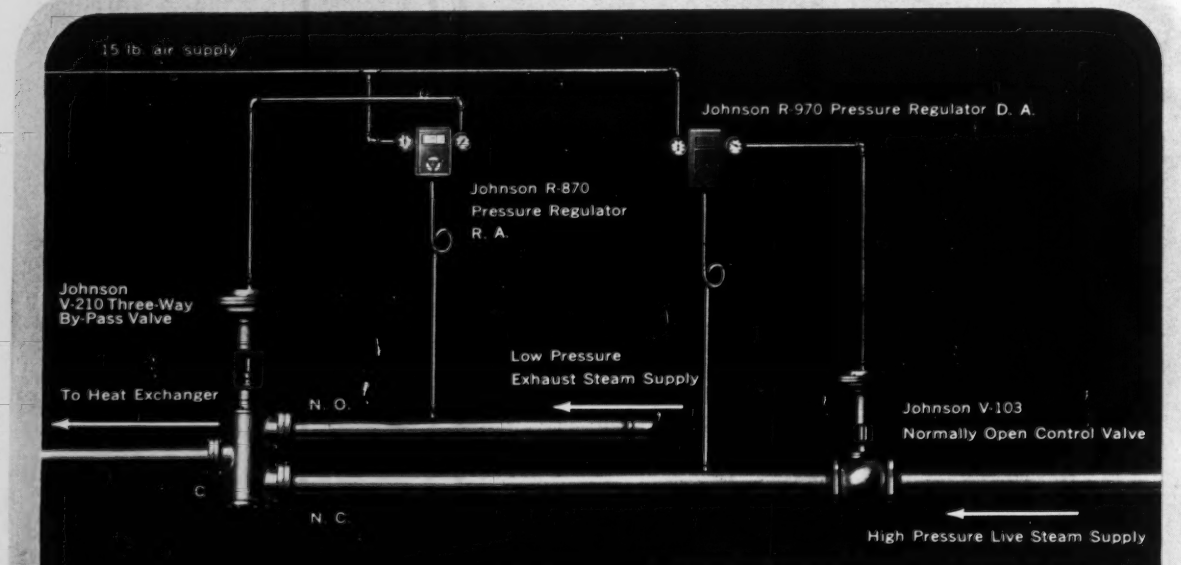

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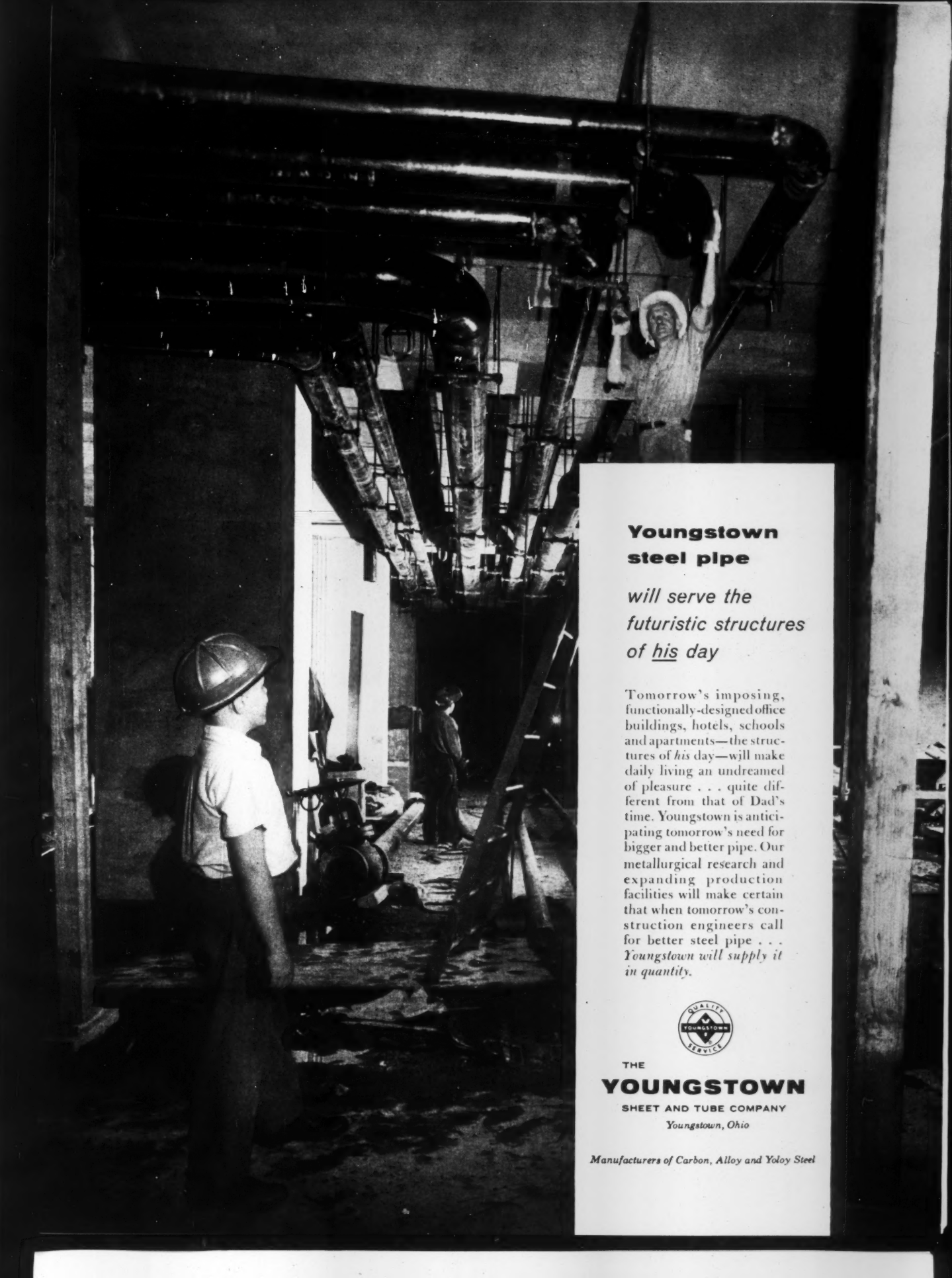

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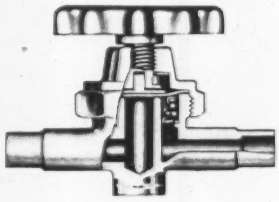

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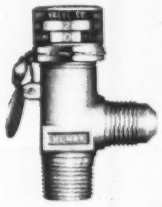

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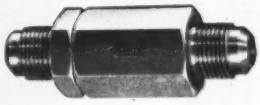

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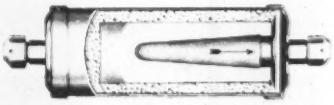

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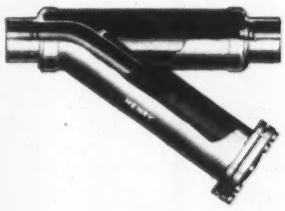

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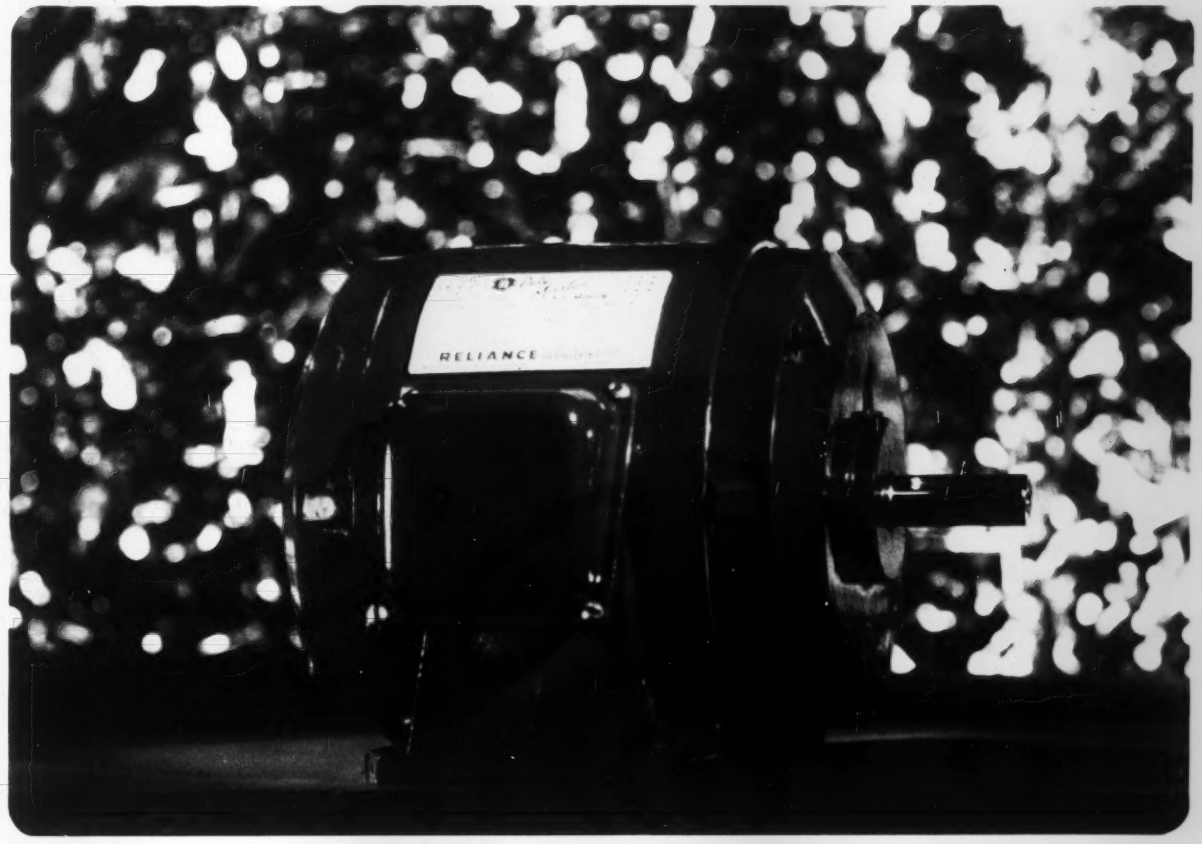

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Available now from stock, 1 thru 250 hp. in all enclosures.

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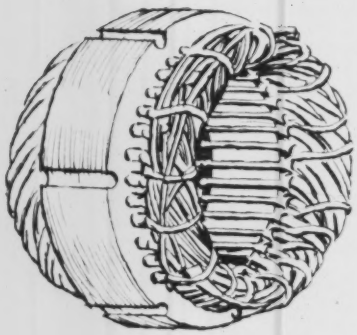
Earl C. Barnes, Chief Engineer

"Duty Master is built to last from the inside out."



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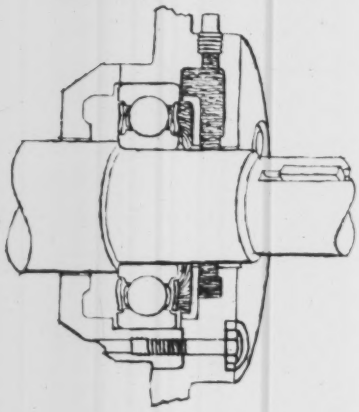

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"Built-in protection was the aim in designing the Duty Master. From the steel core to the cast iron frame, everything possible has been done to insure long life under severe operating conditions.

"The insulation is moisture-proof and acid-resistant. Windings are thoroughly dried, pre-heated and impregnated with multiple dips in thermosetting varnish, and finally given a sealing coat of finishing enamel.

" 'Metermatic' bearing lubrication fits any plant lubrication schedule. Motor bearings are lubricated constantly from a large reservoir. A metering plate feeds measured amounts of grease to the bearing as required. The reservoir and automatic grease relief along the shaft make it impossible to over or under grease the Duty Master.

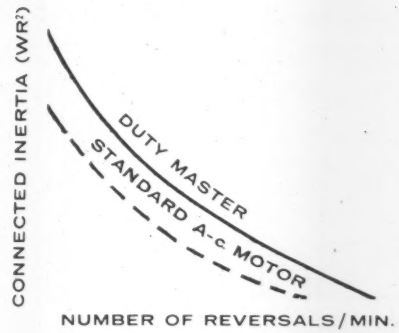
"Whatever your requirements, Duty Master gives you extra built-in protection and longer motor life." *Earl C. Barnes*

RELIANCE Duty Master A-C MOTOR

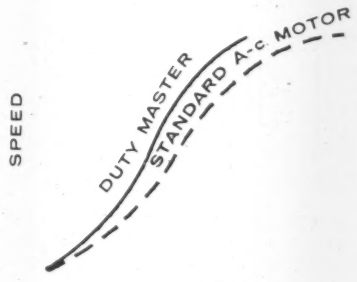
Dr. C. G. Veinott, Chief A-c. Design Engineer

"Duty Master's electrical design provides improved operating characteristics."

REVERSAL



ACCELERATION



"The electrical design of the Duty Master was thoroughly analyzed through the use of digital computors. The purpose of this specialized work was to produce a motor with maximum operating characteristics and maximum efficiency.

"The most visible result of the extensive computor program is the new low inertia rotor. The rotor, like the rest of the Duty Master, takes advantage of new materials and techniques. This rotor, plus better ventilation and other refinements, gives a definite improvement in acceleration, reversals and start-stop performance.

"This is just one example of many mechanical and electrical design changes that make Duty Master a new motor, not just a face lifting." *Dr. C. G. Veinott*

RELIANCE Duty Master A-C. MOTOR

John Walker, Manufacturing Manager

"Manufacturing quality and deliveries are emphasized for Duty Master."

"A motor design is no better than the finished product. That is why we lay particular emphasis on experienced plant people and top quality materials.

"New automatic winders, annealing furnaces, conveyor systems, turning and welding equipment are another part of the quality picture. Equally important is proper scheduling to deliver the motor on time. The new Duty Master is not only an exceptionally good motor, it is an available motor, ready for delivery without unwarranted delay." *John Walker*

Duty Master Motors, 1 thru 250 hp. in all enclosures, are ready for immediate off the shelf shipment from Reliance Distribution Centers and Warehouses across the country. Contact your Reliance Sales Engineer for complete information, or write today for Bulletin No. B-2106.

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"open for discussion"

• We FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

Lauds Data File's Focus on Operation, Maintenance Responsibilities

THE REVIEW of the Air Force air conditioning conference presented in the September HPAC Engineering Data File brings into sharp focus a real problem in all mechanical design and the responsibilities involved therein which the designer frequently is precluded from assuming. Much of the background information included bears out our own observations over a period of years.

Our concept in approach to providing a design and an installation is that the drawings and specifications which we produce as requiring the bulk of our effort are useless of themselves unless we can provide through them a facility operating properly with minimum maintenance five, 10, or 15 years hence. It is not enough that installations should operate with minimum maintenance; it is our responsibility to provide a means of performing all of the required preventive maintenance completely and simply.

From time immemorial the contractor has been required to provide all of the material listed in the review, including catalog data, parts lists, and operating and maintenance instructions. The material provided under such requirements is never complete, requires maintenance personnel to read all the fine print and all the manufacturers' material, and results in improper operation and finally early replacement.

Resigning ourselves to this as a fact, some 13 years ago we started development of operating and maintenance instructions ourselves, requiring from the contractor only complete cataloged data, checked on the jobs for types of bearings and other factors, so that proper operating and maintenance instructions could be written. Originally, we assumed the costs involved. Within the last eight years, our cost has been defrayed under allowances provided in the specifications for preparation of operating and maintenance instructions.

These instructions include descriptions of systems, instructions for operations such as switching and control, maintenance instructions giving detailed observations or work required on each type of equipment, and finally a maintenance schedule by days, weeks, and months, referring to the maintenance instructions, and providing a means of check-off, if desired. On a $1 million high school, for instance, the material may run to three 3 in. ring note books, of which three sets are provided the owner. One is retained in the office to assist with problems as they arise. And they do arise.

This then is our responsibility in connection with a facility we design; a responsibility we cannot shirk or avoid.

There are two other responsibilities we cannot escape: These are adjusting systems and so-called "crank-up." Adjusting distribution systems, such as air or hot water, is normally performed by us, also under an allowance, or by a complete adjusting service, which has not been available here until recently. The "crank-up" is a matter of actual operation of all phases of a system, observation of conditions under such operation, and other factors normally a part of a final inspection.

Under architect-engineer contracts with the armed services, normally only the design phase is included and the consulting engineer's activity extends only through development of plans and specifications. Inspections, checking shop drawings, adjusting, and development of instructions for preventive maintenance are not only included but excluded. We have had only one such contract in which development of operating and maintenance instructions was included.

Sometimes an optional clause for exercise by the government is included for checking shop drawings, but this is usually not employed. Thus, assistance of the designer in helping to select equipment on the very open type of specification employed is not utilized.

It is gratifying to see the new approach of the armed forces on the subject of suitable equipment and concern about the cost of maintenance and replacement due to lack of suitable preventive maintenance. Many air force and other bases have employed military personnel for preventive maintenance, frequently even short-enlistment personnel. This undoubtedly has cast a sharper focus on the entire subject.

It is my hope that the experience of the Air Force

recited in the report will point up certain needs in civil work and be beneficial therein, as well as in military work.

J. Donald Kroeker
J. Donald Kroeker and Associates
Consulting Engineers

Wants More Technical Information On Lansing School HTHW Heating Job

I was most interested in the article, *How HTHW Meets Heating Needs of This New School*, by Anton Krapek (August). The use of high temperature hot water for school heating showed considerable forethought and will provide an interesting example which no doubt will be the forerunner of a number of projects.

Unfortunately the article does not give enough technical information and I feel readers should have some additional information with regard to the initial capital cost. Also, future maintenance costs should be considered, as it is generally found that maintenance costs with HTHW are relatively low. Operating costs should also prove to be low. Adding all these factors to the considerable advantage of being able to combine the system with summer cooling, surely it is high time that this type of system is used in similar buildings, on a larger scale.

My only recommendation would be that all circulating pumps should be duplicated on a standby basis.

I consider the scheme to be a very commendable one and would like to congratulate the engineers concerned. Perhaps they would be prepared to give us a more technical article after the system has been operating for a reasonable period of time.

In Europe, the system would be regarded as a medium temperature hot water system. I see no reason personally why higher temperatures could not have been provided, but there must have been very good justification for using the temperature of about 320 F.

George Applegate, Jr.
G. Applegate & Sons, Ltd.
Engineers and Contractors
Tronchridge, England

The author's reply — I wish to thank Mr. Applegate for his kind remarks. I feel that he is probably well aware of the battle we must wage in the use of HTHW. England and the continent have been far more progressive in its use than have we. To answer his inquiries, I offer the following:

Cost was a consideration on this project as it is on all work that we do and, as previously described, considerable advantages were obtained with HTHW. Tunnel depths were reduced, pipe sizes were much smaller, and pipe covering costs dropped because of pipe size reduction. Radiation costs would remain constant because we used normal temperature distribution methods. Maintenance costs will be cut considerably. However, the client's maintenance department will have to be trained in the proper method of operation of this type of system. Actually, the system should run by itself and need be "tended" only.

I certainly concur with Mr. Applegate for his comment regarding the further use of this type of system.

All pumps were duplicated on a standby basis with the exception of the main boiler feedwater pumps. In this case we have three pumps and three boilers. However, only two boilers will be operating at any one time, the other being shut down for cleaning, maintenance, etc. We therefore could utilize the third shut down pump as a standby unit.

We in this country might also classify our system more of a MTHW system rather than HTHW, but again costs are involved. With 320 F at roughly 100 psi, we are permitted to use standard pattern 125 psi valves, strainers, fittings, pipe, etc. Had we exceeded the 125 psi limitation, we naturally would be required to utilize high pressure pattern (costlier) equipment. Value gained from a higher pressure system would not favorably exceed the additional costs involved.

Anton Krapek
Vice President
E. Roger Hewitt Associates, Inc.
Professional Engineers

Suggests that Globe Valve Be Placed Horizontally to Avoid Corrosion

I would like to submit another possible answer to the question, "*What Causes Our Pipe Fittings to Fail?*" (Question of the Month, May), for consideration by J. B. S.

The unusual condition here is a corrosion breakthrough in the steam line before a corrosion breakthrough occurs in the return line. This occurs not during steam generation, but at idle time and with distilled water. It therefore might be termed standby corrosion. It is due, of course, to oxygen dissolved by the distilled water from air inbreathing when steam is gone likely from an open-to-atmosphere receiver tank.

R. J. Zabłodil (May, pp. 94 and 96) gave the reason: "condensate pockets at the fitting," bridging iron and brass with a solution so that the corrosion electric circuit could be completed. Iron has an inherent potential to dissolve in a solution.

The circuit would be: anode (iron) to solution, through the solution to the cathode (brass), from the cathode back to the anode through the metals. This is an ideal corrosion cell that will continue its corrosive action as long as the solution remains and oxygen is available.

One suggestion would be to place the brass steam globe valve in a horizontal position so that the condensate will drain away as it does in the return line.

C. I. Baker
Chief Engineer
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question of the month

"How Can I Figure Supports For a Horizontal Tank?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other answers or comments for publication are invited.

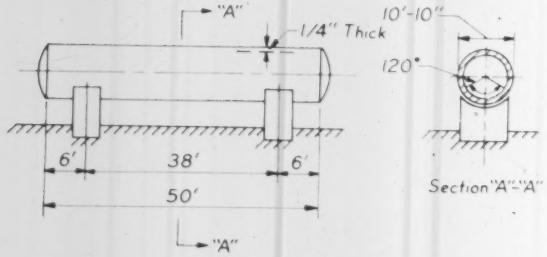
"How should I design the supports for a horizontal tank, 10 ft, 10 in. in diameter × 50 ft long?

"The vessel has been fabricated from ¼ in. thick steel plate and has dished heads. The tank is to be used for ammonia absorption and will be filled with water. The operating pressure will be 25 psi. The tank will be supported by concrete saddles.

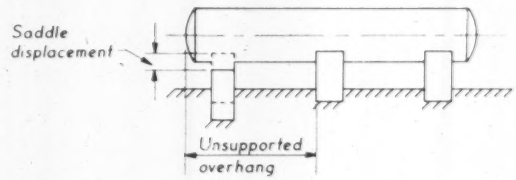
"How far apart should I place the saddles? How many saddles should I use, without placing undue stresses on the shell?" — R.W.G.

Two Supports Are Enough; More Might Present Stress Problem

FOR A VESSEL 10 ft, 10 in. in diameter and 50 ft long, two concrete saddles may be employed, as indicated in Fig. 1. Use of more than two saddles presents a potential stress problem, since it is possible for an outboard saddle to become displaced, thereby imposing additional stress upon the tank and the other supports, as shown in Fig. 2. Unless the tank shell thickness is adequate, buckling may result if this occurs.



1 TWO CONCRETE SADDLES can be used to support R.W.G.'s horizontal tank, as shown above



2 USE OF MORE THAN TWO saddles should be avoided, since an outboard saddle may become displaced and impose additional stress upon tank and other supports

Many horizontal pressure vessels and tanks of greater size and weight have been supported satisfactorily by two saddles only. Reference to various building codes, insurance underwriters' requirements, and other governing agencies will indicate that this type design is preferred.

H. B. WAYNE
Consulting Engineer

Locate Supports for Lowest Moments, Lowest Stresses on Tank

THE SADDLES supporting the tank given by R.W.G. should be two in number. The area of contact between the tank and the saddles should extend over an arc of at least 120 deg.

In the design of the saddles, consideration must be given to the thrust exerted by the tank, due to its thermal expansion or contraction. The tank should be permitted to expand. The resistance to thermal movement is equal to the expected frictional force between

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Keeping a school upright is a new assignment for Electro Dynamic motors. But their dependability and standout life expectancy have been a byword for 80 years.

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The big problem that builders face in this near-Arctic area is permafrost—the waterlogged, frozen tundra that partially thaws from summer warmth. Foundations crack when the ground thaws, so buildings are usually erected on pilings sunk deep into the earth.

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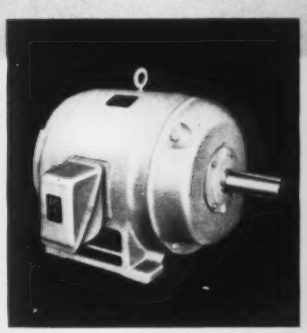

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the tank and the supporting structure.

In order to locate the saddles so that minimum stresses are induced on the tank, consider the tank as a uniformly loaded beam supported as shown in Fig. 1.

The bending moment at the supports due to the cantilever loading is:

$$M_1 = wl_1^2/2 \quad \text{.....[1]}$$

In a simply supported isolated beam AB, the bending moment at the center would be:

$$M_2 = wl_2^2/4 \quad \text{.....[2]}$$

However, for the best distribution of stresses, one half of M_2 must be assigned as a negative moment at the saddles, and the remaining half as a positive moment at the center, so that

$$M_3 = M_4 = -M_1 \quad \text{.....[3]}$$

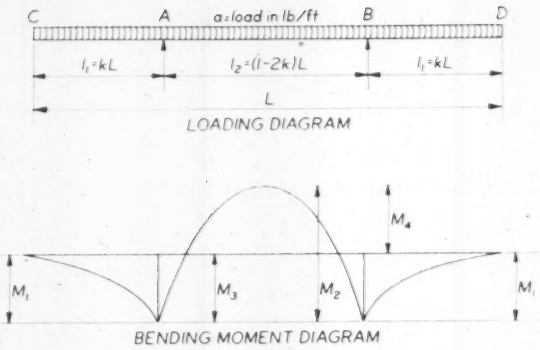
This condition gives the lowest bending moments on the tank, and consequently the lowest stresses.

Now, if we let $l_1 = kL$, then $l_2 = (1 - 2k)\ L$. Substituting these values in Equations 1 and 2, we obtain:

$$M_1 = (w/2)\ k^2\ L^2 \quad \text{.....[4]}$$

and

$$M_4 = M_3 = -(1/2)\ (w\ L^2/8)\ (1 - 2\ k)^2 \quad \text{.....[5]}$$



1 TO LOCATE SADDLES for minimum stresses, consider tank as uniformly loaded beam supported at A and B in loading diagram. Through bending moment diagram and equations 1 through 5, points A and B are located

Through Equations 4 and 5 we find that $k = 0.207$. This value of k yields the lowest moments and lowest stresses on the tank.

ANTONIO DI LORENZO
Engineer

READER ASKS—

"How Should Central Plant Heating Be Controlled For Multi-Building Heating Installation?"

"Several existing buildings, each having their own hot water heating systems, are to be heated from a centralized boiler house. The new mains will be low pressure forced hot water, the pump requirements being 300 gpm against a 25 ft head. Two of the existing buildings are required to have some form of automatic heat control, preferably a three-way mixing valve to regulate the heat output in accordance with the outside temperature.

"I believe the way to do this is to have another pump to circulate the required amount of water through the local heating circuit. As the pump for the mains will be much larger than the pump on the local circuits, the circulation will tend to be reversed, no heat control then being possible. To overcome this, I understand a small cylinder may be inserted where the mains connect to the local system, the flow and return of the mains connecting to one side of the cylinder, and the flow and return to the branches connecting to the other, allowing the pressure difference across the mains to be dissipated.

"If this is so, I would like to know how to size the cylinder, or what should be done.

"Each building requires some 600,000 Btu per hr, and it is assumed that the individual systems were originally designed for an outside temperature of 30 F and flow and return temperatures of 180 to 140 F."—L.A.D.

• *YOU ARE INVITED to contribute a question for publication, or an answer to a published question. Please address your reply to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

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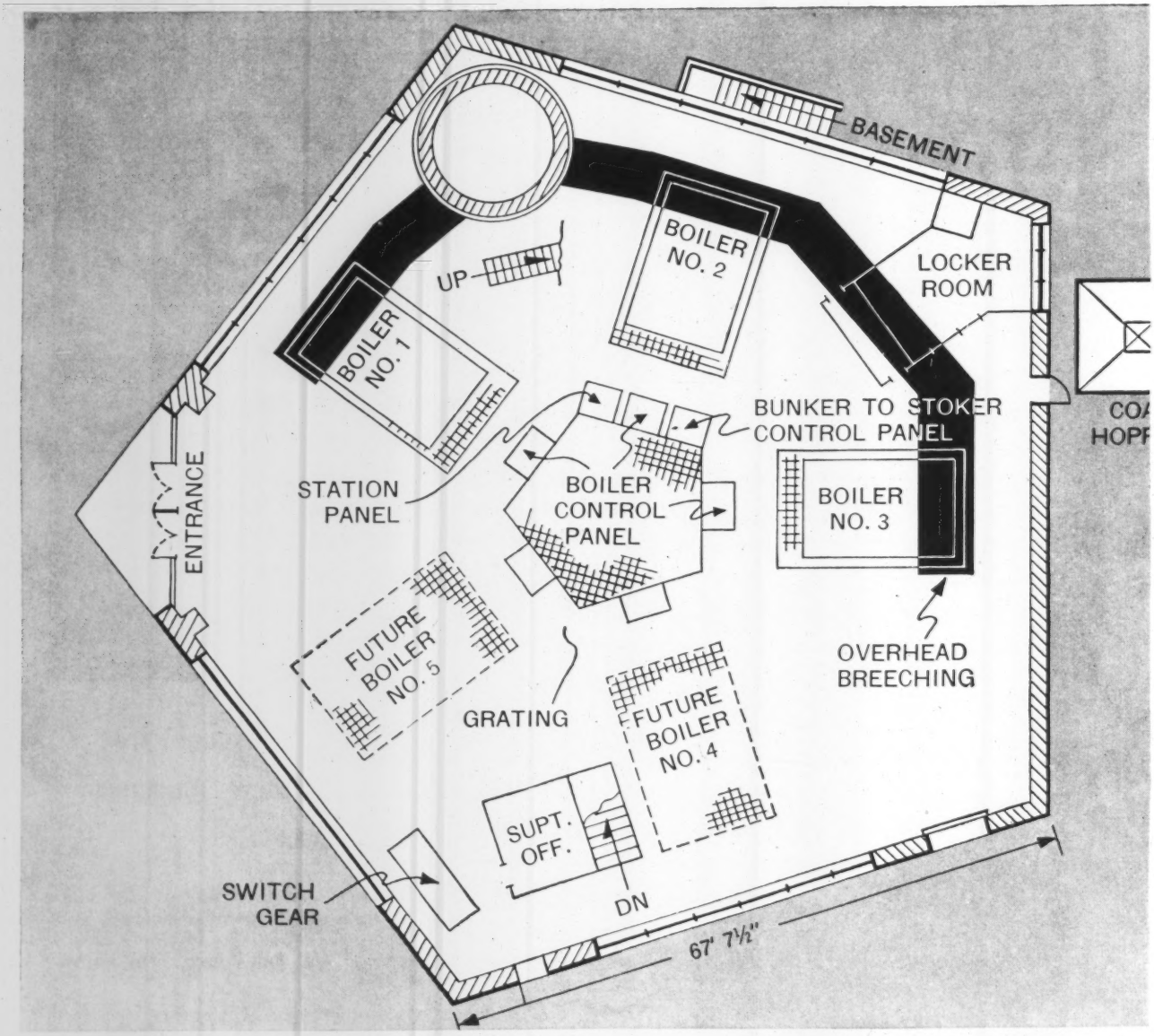
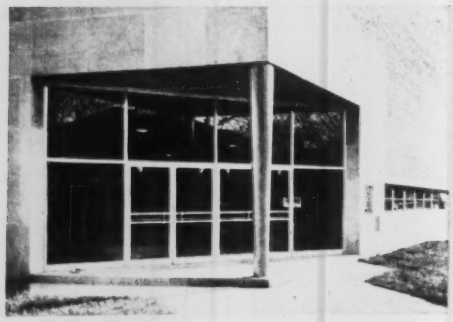
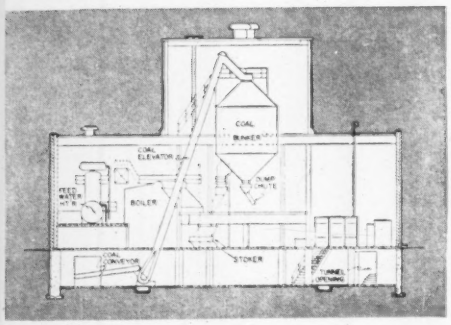




Entrance to unusual "little Pentagon" structure. This shape gives maximum space utilization and allows one-man central control of all boilers. Construction provides comfortably for three 31,000 lb/hr boilers and allows for two similar units in the future, within 7,000 sq. ft.



Elevation shows how coal moves from incoming conveyor by 25 ton/hr. Stephens-Adamson Redler elevator to overhead bunker (capacity 125 tons). Coal feeds from here to scales, then directly into stokers. Bunker and scales by Beaumont Birch Co.

Coal is brought in by rail and unloaded into track hopper. From here, a Stephens-Adamson conveyor carries the coal into the plant and internal coal handling system.

Hospital cures fuel ills with "little Pentagon"

Richmond State Hospital burns coal for economy and availability in modern pentagonal power plant

After a power system failure at the Richmond State Hospital, Richmond, Ind., the administration conducted an engineering survey of its steam-generating operation. Over-age equipment indicated the need for entirely new facilities. The shape of the boiler room site prompted the unconventional pentagonal installation for best possible adaptation of space to present and future needs. *Economy* and *availability* dictated the choice of coal as the fuel.

Today a new power plant—designed by Fleck, Quebe and Reid, Indianapolis, with F. B. Morse, of Purdue University—burns coal in a completely modern, automatic operation. The outstanding features of this compact installation are its high combustion efficiency, minimum manpower requirements and continuing ease of maintenance.

Coal is lowest cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

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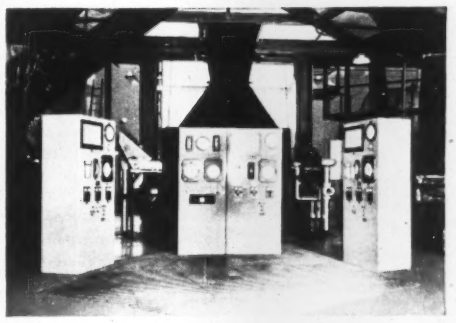

Shown are three Henry Vogt boilers, fed by Laclede chain grate stokers, with individual control panels. Controls are pneumatic type, by Copes Vulcan. From boilers, ashes are moved pneumatically by United Conveyor Ash handling system to silo for disposal.

SEND COUPON FOR NEW BCI PUBLICATIONS. Guide Specifications, with complete equipment criteria and boiler room plans:

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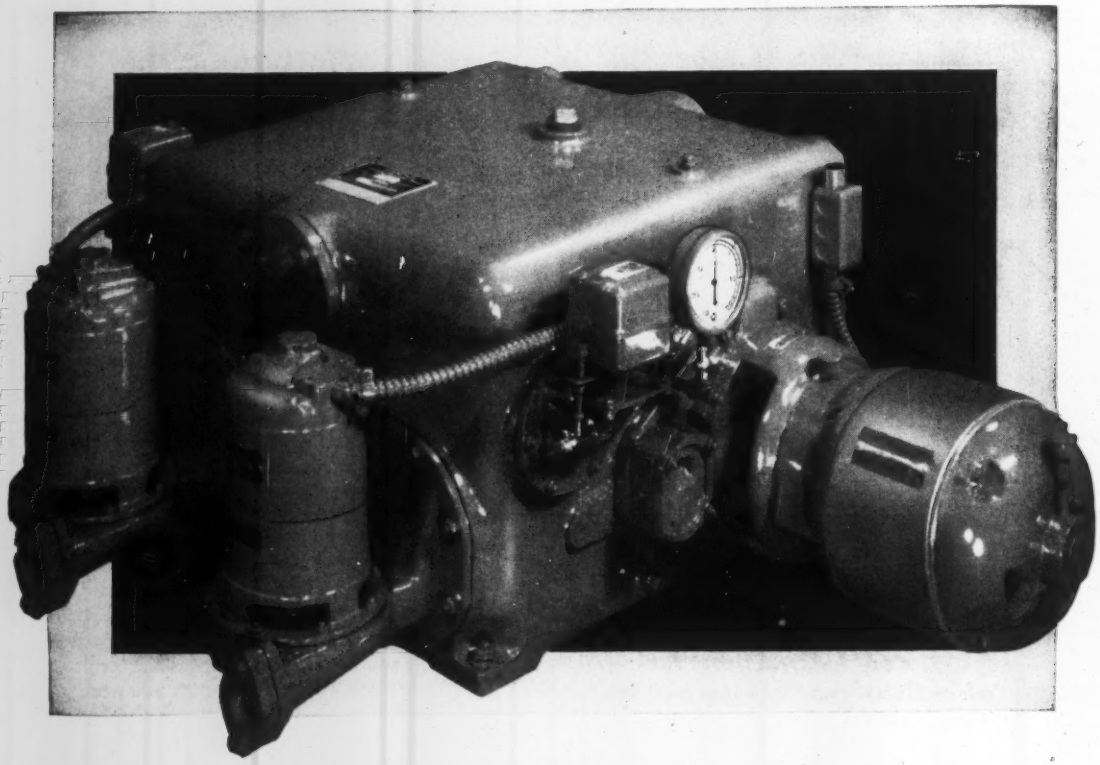
THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS



It's the Nash CSM

No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
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- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

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Control Air Conditioning Noise In the Advanced Planning Stage

BY CLAYTON H. ALLEN
Senior Consulting Engineer
Bolt, Beranek, and Newman, Inc.
Acoustical Consultants

● **Proper air conditioning noise control is more than just the reduction of noise. Rather, it is the adjusting and shaping of the noise background to meet the demands, first for speech communication, second for privacy, and third for comfort. The success of a noise control solution depends upon evaluation of the problem early in the system's design stage. The final results depend upon meticulous attention to details in the installation of all noise control means. The author herein outlines some of the design considerations in noise isolation.**

Dr. Allen received a BS in physics from Worcester Polytechnic Institute in 1940 and a masters from Pennsylvania State University two years later. He was awarded his PhD from Penn State in 1950, at which time he was placed in charge of the sonic and ultrasonic research and development program at Corning Glass Works. He joined Bolt, Beranek, and Newman in 1954. A member of the TAC on Sound and Vibration Control of ASHAE during 1956-57, he was a co-author of the chapter on sound control in the Guide.

IT IS SAFE to say that not a single public building today is built without some form of major mechanical equipment installation. The increase in the public demand for air conditioning and ventilation and the public awareness of the associated noise problem is focusing attention on noise control.

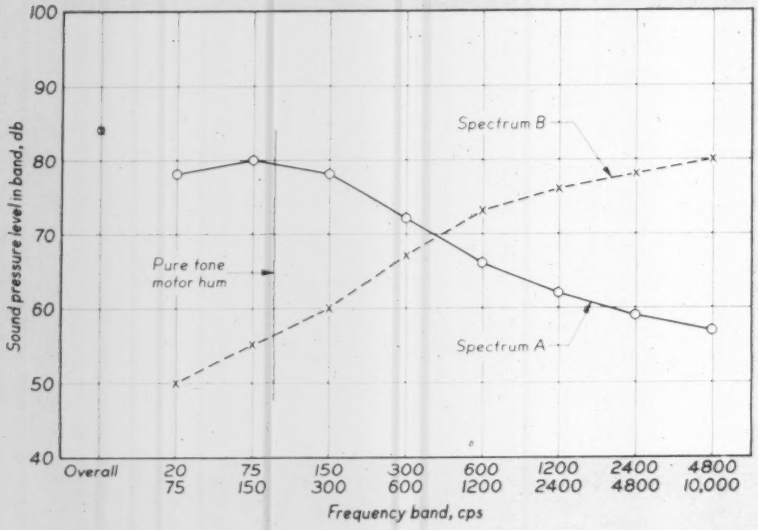
The use of air conditioning systems has largely eliminated outside noise. But it has added entirely new problems which test the patience and skill of mechanical engineers. Increases in building costs have forced lighter building construction, and the demands for tighter space utilization have caused the occupied spaces in buildings to encroach upon the mechanical system area. In many instances, these demands have forced the use of the more compact, noisier high velocity distribution systems.

Not only is noise from a mechanical system itself an important consideration, but the transmission of the noise from one occupied space to another must be considered also. The amount and kind of control required to produce a satisfactory noise environment is determined by a careful balance between the demand for a quiet background and the demand for privacy between spaces.

The purpose of this article is not to present the details of noise control nor to calculate noise levels in occupied spaces. Rather, it is to present an overall picture of the noise control problem; to define the objectives and indicate some available means for providing acceptable noise environments in architectural spaces.

What is noise? There are many kinds. A jet makes noise; so does a fan. These are generally broad band noises containing many random frequencies. They are what we can call loud noises since they interfere, in one

Overall sound level may have no relation to severity of problem



1 THESE THREE KINDS of noise would give same overall noise level on sound level meter. But note difference between types at different frequency bands. Spectrum A corresponds to fan noise; spectrum B to machine shop or assembly building. If pure tone were high pitched whistle instead of motor hum, line would be in higher frequency region of spectrum

way or another, with human endeavors: with concentration, sleep, conferences, etc. This same type of broad band noise at low intensities is as everpresent as air itself and we accept it as a natural part of our environment.

Other types of noise comprise pure tones: a whistle, the whine of a compressor, the hum of a motor. These noises are important to a degree greater than their levels would indicate because their energies are concentrated in narrow frequency bands and they are easily audible above broad band noise of the same total energy.

A third kind of noise includes speech and other intelligible sounds. These are most important in relation to their overall loudness since they carry information. Portions of their information may be perceived even in the presence of relatively high background noise. The tick of a watch announces the passing of time and thus may annoy someone working to meet a deadline. Music from your hi-fi might be very irritating to your next door neighbor. The rattle of a ventilating louver or barely audible conversation, though a very insignificant part of the overall noise environment, may be so irritating as to keep one awake all night. These intelligible sounds which carry information along with them need special consideration in an overall solution of mechanical system noise.

What about noise control? Broad band noise such as that generated by air conditioning systems, when properly controlled, can act as a "sonic perfume": it can cover up smaller, unwanted intelligible noises without itself becoming noticeable or objectionable. Thus, noise control aims at creating a balanced noise environment in which the general level is sufficiently low to permit normal activities but sufficiently high to cover up or mask distracting noises and thus create privacy.

Measure Noise for Quantity, Quality

Noise can be measured. The sound level meter is an instrument which gives a reading indicating the total amount of noise present. But what does this reading mean? The overall sound level may have no relation to the severity of the problem at hand.

We must know more about the noise than its overall level. We must know how it is made up: Is it broad band? Does it contain low frequencies like the hum of a motor? High frequencies like the hiss of a jet? Or pure tones like a whistle? To obtain this information we must analyze the noise. For this we use an octave band analyzer. Frequency is related to a subjective feeling of pitch; sound level is related to loudness. From an octave band analyzer we obtain a value for the sound pressure level for each of eight octave frequency bands.

Sound pressure level is measured in decibels (logarithmic units expressing the ratio of two quantities). The reference unit must be clearly specified in order to give meaning to a decibel value, just as the reference unit must be given for measurements expressed in linear units. We cannot express the length of a room by saying it is 100 units long. Nor can we express sound level by saying it is 75 decibels. Neither of these two measurements is significant. We must say a room is 100 units of 1 ft long

or, briefly, 100 ft long. Similarly, a sound pressure level may be given as 75 db relative to (the customary reference for sound pressure) 0.0002 microbar.

Fig. 1 gives an analysis of noise, showing the distinction between the types of noise described. Three types of noise are shown which would give the same overall noise level reading on a sound level meter.

The noises have been analyzed into eight octaves over the normal audible frequency range with which we are concerned. One spectrum here corresponds to the noise we might get from a fan: strong low frequency rumble, less higher frequency hiss. The second spectrum is characteristic of the kind we would find in a machine shop or an assembly building where many automatic pneumatic tools are operating. The third spectrum shown is a pure tone: the hum of a transformer or a motor. If we had a high pitched whistle, this single line, representing such a pure tone, would be located in the higher frequency region of the spectrum.

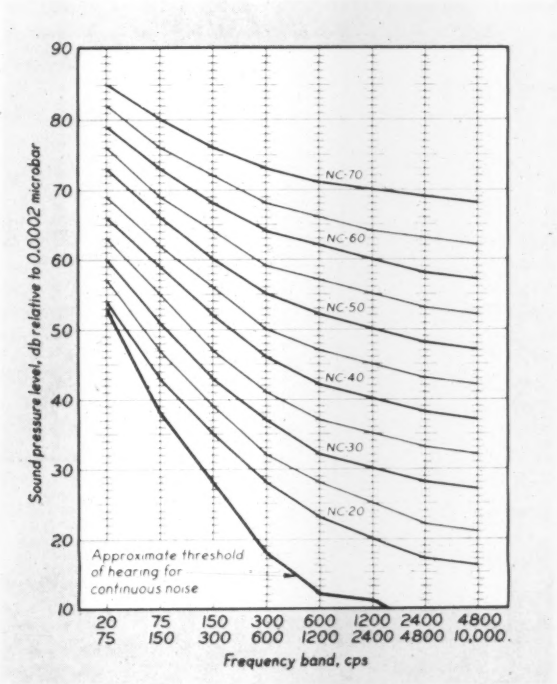
Speech Interference Level Is One Criterion

The degree of interference with speech communication is controlled almost entirely by the background noise in the frequency range from 600 to 4800 cycles. For this reason a quantity called *speech interference level* (SIL) has been defined as the average of the sound pressure levels in the three octave bands 600 to 1200, 1200 to 2400, and 2400 to 4800 cps. Within this range it makes little difference whether the spectrum slopes or not.

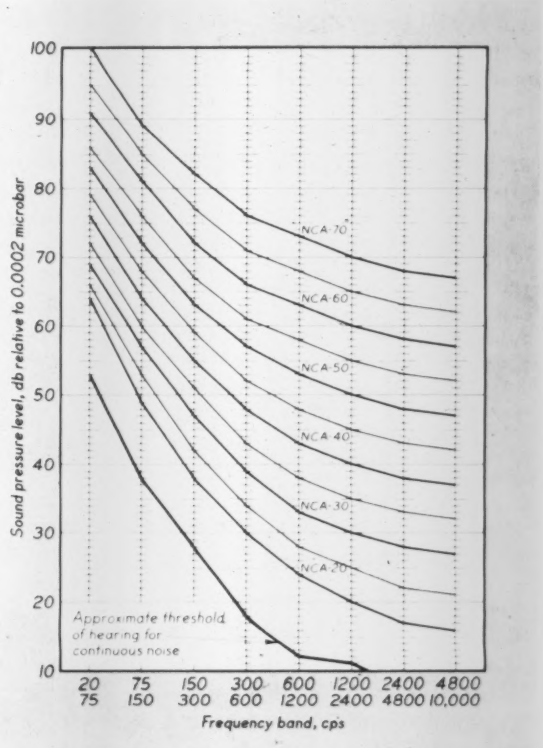
Outside of the SIL region there are other frequencies which have little effect on speech communication but which do contribute to the apparent loudness of a noise. Therefore, from the standpoint of comfort, we should control the noise in these other regions so that they are not overpowering and not too loud for the particular speech interference level that we need.

Tables 1 and 2 relate activities in various architectural

These noise criteria curves denote "speech interference level"



2 NOISE CRITERIA (NC curves) have been developed to give maximum amount of noise considered acceptable in each of eight octave frequency bands. Each spectrum given is characterized by number which denotes speech interference level for this spectrum. Therefore, for a given enclosure, an NC criterion curve is chosen which will give required ease of speech communication. See Tables 1 and 2 on next page



3 WHEN ECONOMY LIMITS degree of noise control to be provided, these NCA curves will give same speech communication with less emphasis on comfort. NCA curves differ from NC curves given in Fig. 2 by an increase in allowable low frequency noise. To go above these criteria for any chosen speech interference level will result in an environment considered "too noisy" by most occupants

spaces[1] with acceptable SIL values. We find that for broadcast studios very low speech interference levels of the order of 15 to 20 db are required. Private offices generally require SIL values of 35 to 45 db.

Having adjusted the speech interference level for the type of communication characteristic of the activities in a particular space, we next need to adjust the rest of the spectrum. Fig. 2 shows a group of office noise criteria (NC curves) which has been developed to give the maximum amount of noise considered optimally acceptable in each of the eight octave frequency bands. Each spectrum given is characterized by a number which denotes the SIL for this spectrum. An NC criterion curve is chosen to provide the required ease of speech communication. Thus, for a private office we might select NC-35 or NC-40. The curve chosen then establishes an acceptable background level in each octave band. If we had a broadcast studio, we would need an SIL of approximately 20. So we would choose the NC-20 curve.

There are occasions when, for economic reasons, we cannot provide quite this much noise control but would like to obtain the same speech communication with a little less emphasis on comfort. For this purpose another set of spectra called NCA criteria curves gives the maximum amount of loudness generally acceptable. The curves are again characterized by numbers giving the speech interference levels. The NCA curves given in Fig. 3 differ from those in Fig. 2 by an increase in the allowable low frequency noise. If you go above these criteria for any chosen speech interference level, the result will be an environment which is generally considered "too noisy" by most occupants.

NC criteria were developed primarily for office situations. However, they have been found to apply quite successfully to other occupied spaces: concert halls, sports arenas, schools.

Consider the System as a Whole

Let's turn to the problem of noise control itself. A noise problem should be evaluated initially from the standpoint of the *whole* system as a noise source. A mechanical system consists of, in general, a source of noise, some kind of a receiver which is generally a person, and some path between the two. Usually a mechanical system has not just one noise source but many: fans, pumps, motors, gears, dampers, valves, etc. Many receivers are in various parts of a building, and many paths join all these sources and receivers. So the problem becomes very complicated and must be considered as an overall system when defining noise control measures.

The most effective noise control can be obtained in the advanced planning stage. The amount of change required at this stage generally costs far less than the same amount of noise reduction applied as a corrective measure later on.

Planning starts with the positioning of noisy areas far from the quietest areas, arranging the mechanical equipment so that it is not close to bedrooms, private offices, or executive suites. Planning includes building design to avoid such errors as the placing of concert halls next to very noisy mechanical equipment, or recreational areas next to quieter operating areas.

Choice of equipment that will go into a mechanical sys-

TABLE 1 — RECOMMENDED NOISE CRITERIA for offices, based on curves given in Fig. 2, are listed below. Noise measurements made for purpose of judging satisfactoriness of noise in an office by comparison with these criteria should be performed with office in normal operation, but with no one talking at the particular desk or conference table where speech communication is desired (i.e., where the measurement is being made). Background noise with office unoccupied should be lower, say by 5 to 10 units

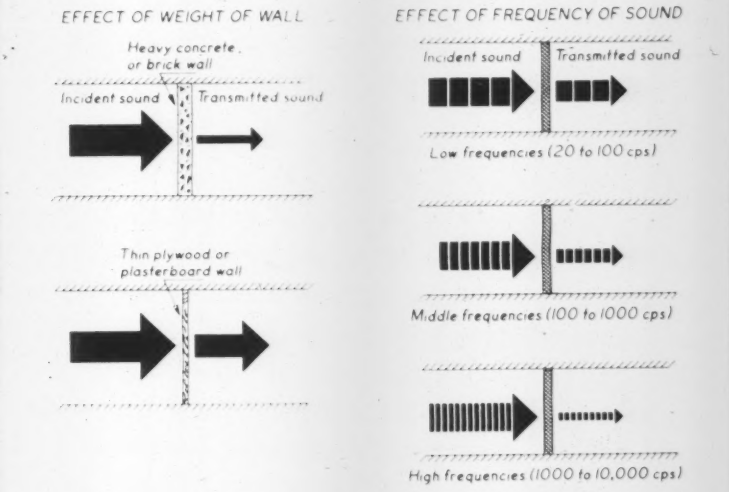
NC Curve of Fig. 2	Communication environment	Typical applications
20 to 30	Very quiet office; telephone use satisfactory; suitable for large conferences.	Executive offices and conference rooms for 50 people.
30 to 35	"Quiet" office; satisfactory for conferences at a 15 ft table; normal voice 10 to 30 ft; telephone use satisfactory.	Private or semi-private offices, reception rooms, and small conference rooms for 20 people.
35 to 40	Satisfactory for conferences at 4 to 8 ft table; telephone use satisfactory; normal voice 6 to 12 ft.	Medium sized offices and industrial business offices.
40 to 50	Satisfactory for conferences at a 4 to 5 ft table; telephone use occasionally slightly difficult; normal voice 3 to 6 ft, raised voice 6 to 12 ft.	Large engineering and drafting rooms, etc.
50 to 55	Unsatisfactory for conferences of more than two or three people; telephone use slightly difficult; normal voice 1 to 2 ft; raised voice 3 to 6 ft.	Secretarial areas (typing), accounting areas (business machines), blueprint rooms, etc.
Above 55	"Very noisy"; office environment unsatisfactory; telephone use difficult.	Not recommended for any type of office.

TABLE 2 — NOISE CRITERIA for rooms are recommended as indicated below. Levels are to be measured in unoccupied rooms. Each noise criterion curve is a code for specifying permissible sound pressure levels in eight octave bands. It is intended that in no one frequency band should the specified level be exceeded. Computed equivalent dba numbers in right-hand column are presented for information only and are not recommended for use in specifications. Ventilating systems should be operating; outside noise sources, traffic conditions, etc., should be normal when measurements are made

Type of space	Recommended noise criterion curve of Fig. 2 or Fig. 5	Computed equivalent sound level meter readings*
Broadcast studios	15 to 20	25 to 30 dba
Concert halls	15 to 20	25 to 30 dba
Legitimate theaters (500 seats, no amplification)	20 to 25	30 to 35 dba
Music rooms	25	35 dba
Schoolrooms (no amplification)	25	35 dba
TV studios	25	35 dba
Apartments and hotels	25 to 30	35 to 40 dba
Assembly halls (amplification)	25 to 30	35 to 40 dba
Motion picture theaters	30	40 dba
Hospitals	30	40 dba
Churches	30	40 dba
Courtrooms	30	40 to 45 dba
Libraries	30	40 to 45 dba
Restaurants	45	55 dba
Coliseums (for sports only, amplification)	50	60 dba

*If there were relatively less noise in the low frequency bands than indicated by the recommended noise criterion curve, the dba numbers would be lower by about 5 dba. All numbers in this column should be dropped by 5 dba if they are to be used to estimate the compliance of a normally encountered noise level with an NC criterion; these numbers should not be used for specification purposes.

Transmission depends on wall construction, sound frequency


EFFECT OF WEIGHT OF WALL
Heavy concrete or brick wall
Incident sound
Transmitted sound
Thin plywood or plasterboard wall
EFFECT OF FREQUENCY OF SOUND
Incident sound
Transmitted sound
Low frequencies (20 to 100 cps)
Middle frequencies (100 to 1000 cps)
High frequencies (1000 to 10,000 cps)

4 THIS IS WHAT HAPPENS when a noise passes through various types of walls. Note that a heavy wall is more effective in isolating sound than a light one; that, for any one wall structure, isolation of sound increases with frequency

tem is important in the design stage. Some types of equipment are more applicable to a large installation, other types are applicable to a smaller installation, purely from a noise standpoint. Operationally, they may be equivalent, but the choice between the two can be made, in many instances, on the basis of their noise output. In any installation there must be a close coordination between architectural design of the building and the mechanical system in order to get an integrated overall optimum system.

Noise criteria may be different in different spaces. As we have seen from Tables 1 and 2, a noise level in a secretarial office may be as high as an NC-55. A private office may be in region of NC-30 to NC-40. The noise sources in such an installation are not confined to the mechanical equipment, but include also sources in adjacent offices.

Noise may transmit from one office to another through the wall, through the air conditioning system, or up over a tile ceiling. Proper location of some of the treatment used to control mechanical equipment noise may be made to serve double-duty by simultaneously reducing interoffice noise.

The equipment can house many noise sources. These transmit noise into an associated space directly through the wall, perhaps through the duct system, and also through the solid structure of the building. Vibration may travel for 100 ft or more in the building structure, and be re-radiated through the floors and the walls in remote areas. This exemplifies the need for considering the overall system in a noise control problem.

Isolate Noise Various Ways

Isolation can be produced by various means. A heavy wall can separate the mechanical equipment and office spaces, or a corridor or recreational area can be placed adjacent to the mechanical room and the private offices put in some more remote location.

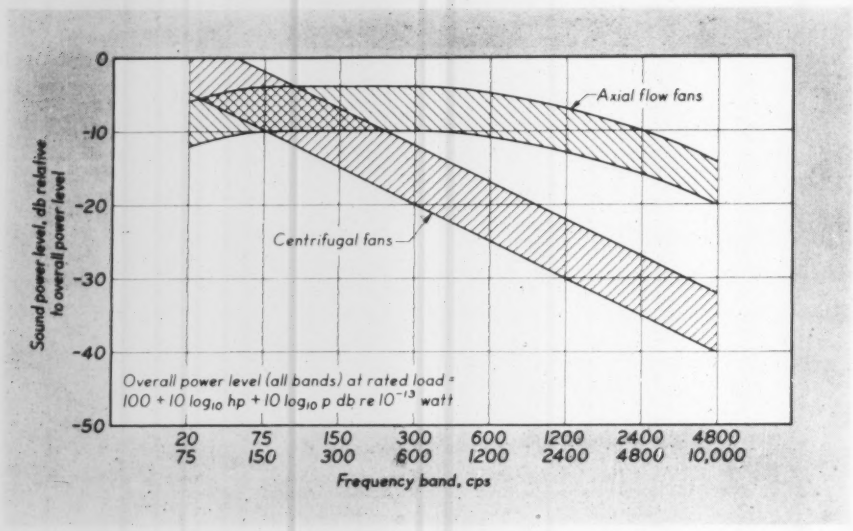
Fig. 4 represents what happens to noise passing through various types of walls. A heavy brick or concrete wall will transmit little sound as compared to a plywood or plasterboard wall. The noise transmitted is therefore a function of the construction of the wall—its size, shape, and material. In general, a wall is less effective in isolating low frequencies than it is in isolating high frequencies.

To produce a required noise isolation from a fan room, the source of a great deal of low frequency noise, we must generally use a heavy concrete or brick wall between it and the occupied spaces. In office spaces, which are relatively quiet, we may be able to employ removable partitions satisfactorily if the background noise levels are properly adjusted.

Properly designed vibration mountings serve as excel-

[1] *Noise Criteria for Office Spaces*, by L. L. Beranek, Journal of the Acoustical Society of America.
Revised Criteria for Noise in Buildings, by L. L. Beranek, Noise Control, January 1957.

How noise spectra of centrifugal, axial flow fans differ



5 FANS ARE PRINCIPAL SOURCES of noise in air conditioning systems. Noise is at a minimum at point where fan is operating most efficiently. Noise spectra from conventional fans are shown at left. Centrifugal fans generally have sloping spectra; those of axial flow fans are usually more nearly flat

lent absorbers of noise and vibration. When a vibrating machine is bolted to the floor, it may create a vibration in the building structure. Improperly designed mountings may be even worse than no mountings at all. Proper design will permit the machine to vibrate and produce very little force against the floor.

Adequate noise isolation also involves the installation of properly designed flexible connections in piping. Generally, the addition of a heavy mass after the second isolator will improve the isolation. Isolation hangers provide further improvement and, where needed, should be provided for in the initial design.

Fan Is Main Air Conditioning Noise Source

The principal noise source in an air conditioning system is usually the fan or fans. Fan noise is at a minimum at the point where the fan is operating most efficiently. This is indeed a fortunate coincidence and should not be ignored in the design of a system. Proper design may save as much as 5 db in the required noise isolation.

When a conventional air conditioning fan is operated at its most efficient point, the noise output expressed as an overall power level, PWL, can be estimated[2] from the relation:

$$\text{PWL} = 100 + 10 \log \text{hp} + 10 \log p \text{ db re } 10^{-13} \text{ watt}$$

where hp is the fan motor rated horsepower and p is the static pressure in inches of water gage. This relation is not so important here as is the fact that the output of a fan can be predicted. Noise spectra from conventional fans are shown in Fig. 5. Centrifugal fans generally have sloping spectra, while those of axial flow fans are more nearly flat.

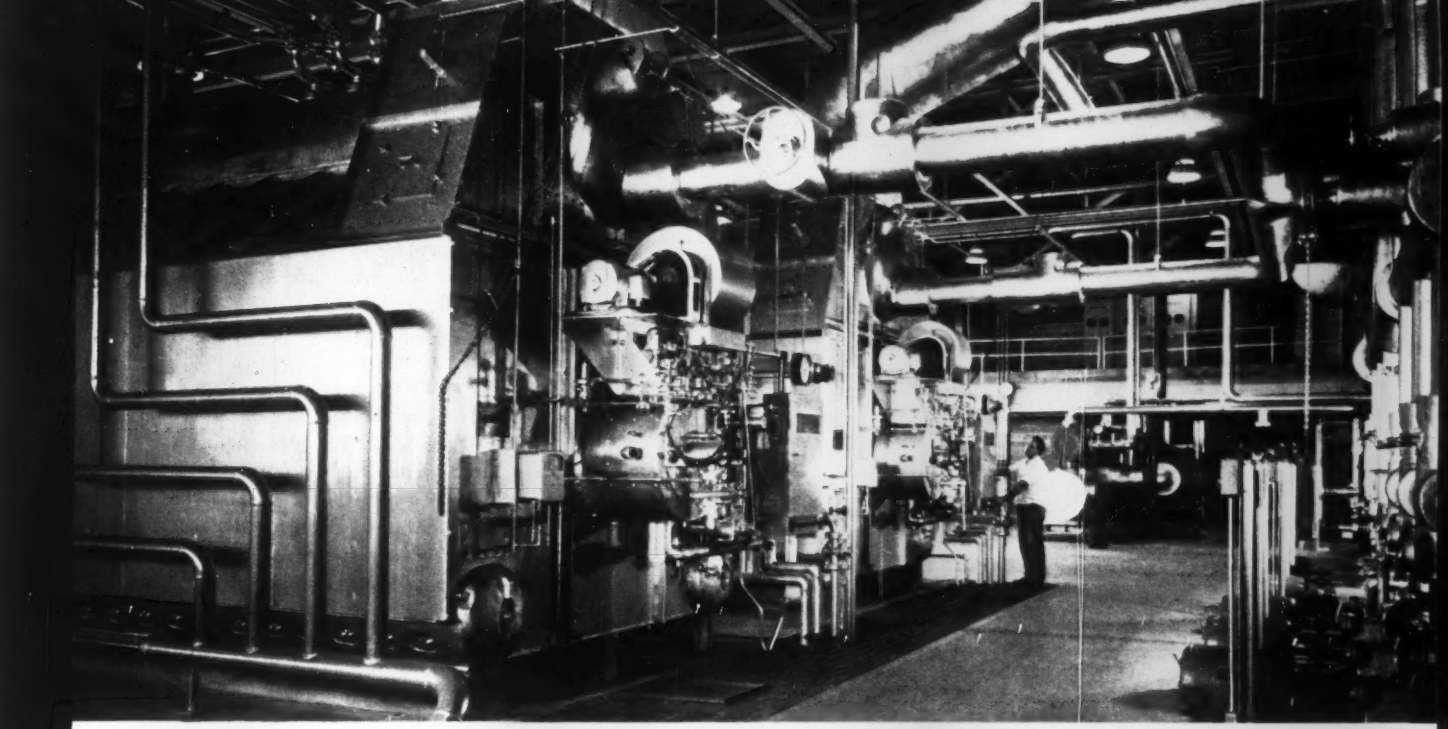
There are many means to isolate noise from a fan in a duct system. Some package units provide large attenuation over a broad frequency range and generally provide more low frequency attenuation than is available from other devices of comparable size. Duct lining will give a peaked attenuation in a relatively narrow frequency range determined by the duct dimensions. A bend will reduce noise, partly reflecting it back toward the fan and partly absorbing it at the reflecting surface. At the open end of a duct, further reduction of noise results from sound reflecting back into the duct, particularly at the low frequencies.

Add High Frequency Noise via Duct Outlets

When sufficient noise reduction is employed to reduce the low frequencies to an acceptable level, more high frequency noise may be removed than desired. This results in a spectrum which is sloping more rapidly than the chosen NC criterion curve. The high frequency noise needed for privacy can be regained by adding noise from properly sized outlets. It may appear strange to recommend the addition of noise in a mechanical system, but it may be necessary as part of a balanced noise background designed to optimize both ease of speech communication and privacy.

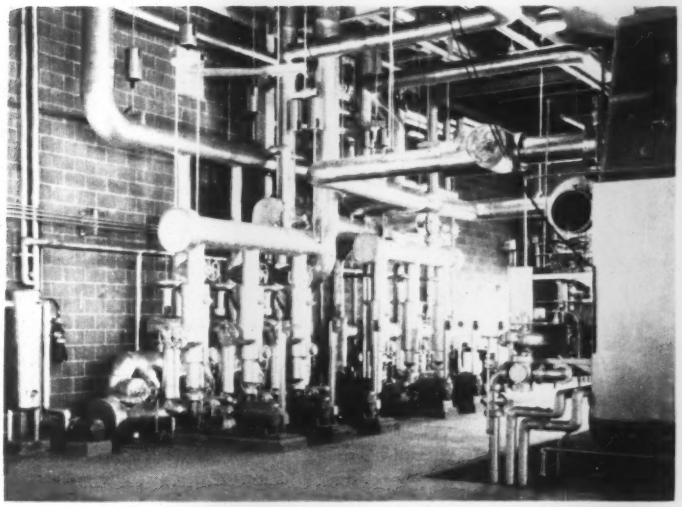
Outlet noise should be considered as the first of the noise control measures. It should be adjusted to a value just below the criterion level, to avoid the need for resizing outlets and rebalancing the system later. ±

[2] *Noise from Air Conditioning Fans*, by C. H. Allen. Noise Control, January 1957.



HIGH TEMPERATURE HOT WATER for process and building heating requirements at Cutler-Hammer, Inc.'s recently completed plant in Lincoln, Ill., is supplied by these two 25 million Btu per hr hot water generators. Units are fired automatically and equipped to use either natural gas or No. 6 fuel oil

HTHW Serves Process Heating, Comfort Needs of New Plant



SIX PUMPS circulate HTHW through two circuits: one for heating, one for process. Plant's heating systems are entirely closed and steam is prevented from forming by keeping compressed air above water in an expansion tank at a pressure about 15 psi greater than saturated steam at 305 F

BY ROLLIN R. EIBER
Chicago District Manager
and
WILLIAM S. ROGERS
Senior Mechanical Designer
The Austin Co.
Engineers and Builders

THE CHOICE of a high temperature hot water system to satisfy the comfort and process heating needs of the new Cutler-Hammer, Inc. plant at Lincoln, Ill., was based on a careful analysis of the immediate needs of the building and on plans for future expansion of the plant in three directions after the first phase was completed.

Large unobstructed floor areas, necessary for fast and efficient movement of materials by use of lift trucks, conveyors, monorails, and

Plant's exclusive use of HTHW for both heating and process affords savings in installation and maintenance costs

cranes, were another consideration that influenced the design of the overall heating, ventilating, and air conditioning systems for this new plant.

Two types of heating systems, both using high temperature hot water, were considered because of the large building area involved and because of the low maintenance costs experienced with this type of system:

1) High pressure steam for process heating and high temperature hot water for building heating.

2) High temperature hot water for both process and building heating.

A major portion of the process heating is the plating room's demand. Initially, the first type of system seemed to be the wisest choice, especially when the plating equipment manufacturers seemed hesitant to use any heating medium other than high pressure steam for this equipment.

However, after a series of conferences with the various manufacturers of plating equipment and after checking on the amount of heat transfer surface required to do the heating with high temperature hot water, it was decided that HTHW would satisfy the process heating requirements if 300 F water were used. This, therefore, is one of very few such plating room installations that are served by HTHW.

The second system was definitely the most economical solution to the problem, since it eliminated the secondary heating surfaces required by conversion under system No. 1. In addition, some first cost savings could be realized, as could a relatively low maintenance cost. Consequently, system No. 2 was adopted as the basis for the design, using 300 F water supplied for both the process and building heating requirements.

Primary heating is supplied by two 25 million Btu per hr HTHW generators equipped for firing with combination burners using No. 6 fuel oil or natural gas. Fuel oil is heated by a heat transfer arrangement of water-to-water-to-oil so as to minimize the possibility of contaminating the primary hot water. HTHW is generated at 305 F and pressurized by compressed air.

The building heating equipment utilizes HTHW at temperatures which will vary from 305 F when the outdoor temperature is —10 F down to 130 F when it is 65 F outdoors.

Various Heating Methods Used

Unit heaters are installed around the periphery of the manufacturing area, with large centrifugal fan type heating units supplying heated air at the large doors. These latter units are normally under thermostatic control, but are equipped with door switches to turn them on when the doors are opened, regardless of the thermostatic demand.

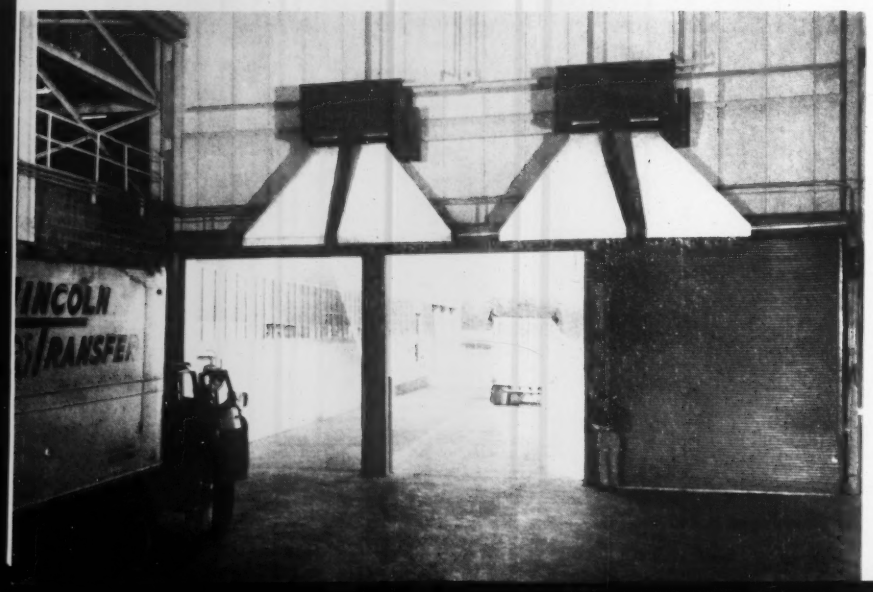
Office areas, the cafeteria and laboratory, and all other locations where personnel are occupied at sedentary jobs near outside walls are equipped with finned radiation. Air conditioning and ventilating units supply heat to offset roof and ceiling losses, and the radiation satisfies the heat losses from the remainder of the exposure.

The building heating supply HTHW temperature is reduced by means of three-way valves in the circulating pump suction lines. These valves are controlled through a master-submaster thermostat control system. Process heating equipment uses HTHW at a constant 305 F at all times. Three process and three building heating water pumps are installed, one of each acting as a standby.

Both generators are the same and can be interchanged during summer operation. This feature facilitates maintenance with no downtime nor loss of any part of plant production.

Condition Six Separate Areas

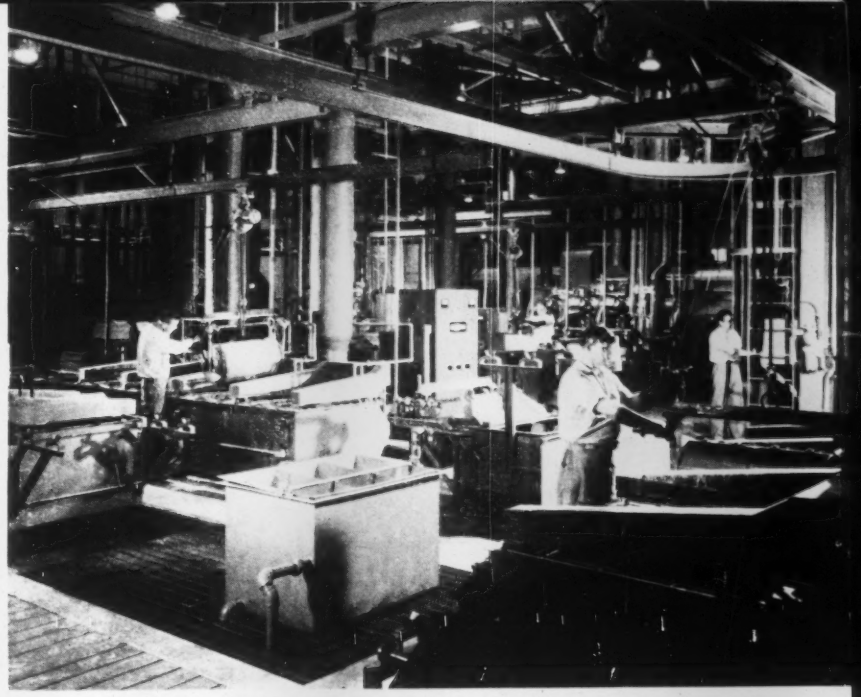
Air conditioning is required at six distinct and separate portions of the plant. A chilled water system was selected because of the relative locations of the refrigeration equipment and air conditioning systems.



BLAST TYPE UNIT HEATERS, each rated 500,000 Btu per hr, are installed at truck and railroad doors. Heaters operate automatically when doors are open, providing curtain of heated air which keeps cold air from entering building

Locating the centrifugal refrigeration compressor in the boiler room provides a centralized location for the supervision of the primary heating and cooling equipment. Hot and cold deck type multi-zone air conditioning units provide comfort air conditioning in the office, laboratory, and circuit breaker assembly department. The circuit breaker room requires air conditioning because changing temperatures can vary the calibration of the instruments. Other air conditioning units coupled with zone reheating coils provide air conditioning for the IBM equipment and lunch rooms.

Approximately 12,000 ft of ductwork conveys 550,000 cfm of air for ventilating and air conditioning these six areas.



IN PLATING ROOM, HTHW is used for all process heating needs—rare for plating rooms. Installation was made after checking with plating equipment manufacturers on amount of heat transfer surface required

Use Plastic Ducts, Pipe

In the plating room, all process exhaust ducts and hoods removing acid or alkaline fumes are plastic polyester resin reinforced with glass fiber.

Ducts, elbows, and other fittings were welded on the job by saturating the glass fiber mats with a resin containing a hardening agent and then applying them to the sections being joined. The mats were wrapped around the butted ends of the duct sections and then permitted to harden. This hardening takes only about an hour, but the welds could not be subjected to rough treatment for about 24 hours.

Scrolls and wheels for the acid removal system fans are lined with a thin plastic coating. Fans for the alkaline removal systems are protected by pure phenolic coatings.

Plating room waste is destroyed or neutralized before the effluence is discharged to the sewer. The acid drain piping is Schedule 40 PVC pipe and socket type fittings. Valves are PVC screwed type with "teflon" diaphragms. Alkaline lines are Schedule 40 black iron with malleable iron fittings and all valves are iron and of the Y-pattern diaphragm type. The Schedule 40 black iron cyanide lines have forged steel welding fittings.

Facilities are included in this new plant to destroy toxic chrome and cyanide gases as well as to blend acidic and alkaline wastes produced in electroplating operations. This semi-continuous batch type system has pH controller-recorders to proportion the necessary chemicals into the basins for the destruction and neutralization processes.

Toxic cyanides are destroyed by gaseous chlorine and the hexavalent chromium is reduced to trivalent chromium through the addition of sodium meta bisulfite. These destruction processes are carried out under controlled pH conditions and both waste streams are then blended in the final neutralization basin where the pH is suitably adjusted prior to discharging the waste into the sewer system.

PLATING PROCESS SOLUTIONS and chemical wastes from manufacturing operations are fed into this equipment in basement space beneath plating room. Here, they are completely neutralized prior to disposal into main sanitary sewer

18,400 SQ FT of sloping driveway is assured of continuous use during heavy snow and sleet so delivery service to busy Minnesota highway department central office building can go on uninterrupted

Sloping Driveway's Snow Melting System Assures Snowfree, Slipfree Pavement

BY JOHN RUDBERG
Mechanical Engineer
Ellerbe and Co.
Architects and Engineers

• **Snow melting systems, originally considered luxury items, are becoming more and more recognized as essential to driver and pedestrian safety, to maintaining busy thorofares snowfree and icefree, and even to keeping access to building loading and unloading areas open the year 'round. This coming winter, the Minnesota Dept. of Highways' new central office building in St. Paul will be guaranteed uninterrupted flow of delivery traffic, regardless of the weather in this northerly city where heavy snowfalls are common. The 18,400 sq ft driveway—sloping downward from ground level to a below-grade level entrance and thus presenting a safety hazard when icy—is enmeshed with ¾ in. wrought iron pipe supplied by 2 in. headers which circulate an ethylene glycol solution heated by a shell-and-tube steam converter in the building basement. The installation procedures followed, the methods of controlling the system, and the steps taken to guard against slab cracking and to combat heavy drifts at the retaining wall are described in this article.**

John Rudberg received his BS in mechanical engineering from the University of Minnesota under the U. S. Navy's college training program in 1945, and returned to earn his masters two years later. Since his graduation he has been with Ellerbe and Co. in the design of heating, ventilating, air conditioning, and piping systems for commercial and industrial buildings.

". . . eliminates the need for sacrificing the functional layout of the building"

INSTALLATION of a snow melting system in the large sloping driveway to the laboratory section of the Minnesota Dept. of Highways' new central office building in St. Paul was necessary because the downward grade to the building presented problems of maintaining deliveries during sleeting and periods of heavy snow.

With retaining walls around the lower area, snow removal by the old-fashioned means would be complicated because all snow would have to be hauled out to avoid congesting the area with piled snow. The snow melting system assures continuous use and eliminates the need for sacrificing the functional layout of the building — which it would have, were the driveway built at a higher level.

The grids installed in the 18,400 sq ft driveway slab are constructed of 3/4 in. wrought iron pipe spaced 12 in. on centers. Headers are 2 in. Depth of bury in concrete is 2 1/4 in.

Since the driveway is not symmetrical, individual grids vary in length. In some relatively small areas, a serpentine system was required for proper coverage. Balancing cocks for each grid balance out these differences in resistance to flow of the ethylene glycol solution, used as the heating medium. The headers are vented with manually operated air vents which are accessible through cast iron hand holes in the slab.

Minimize Slab Cracking

To minimize the slab's cracking over individual pipes, a 66-66 welded wire mesh was laid over the entire piping system before the concrete was poured. In addition, dummy joints were provided in two directions. These consist of shallow saw cuts which are filled with a sealer to control the location of cracks in larger panels.

All construction joints were keyed together to minimize motion between adjacent slabs. These joints are parallel to the piping grid, so the pipe does not pass through the joints. Expansion joints have dowel pins to prevent vertical motion. A compressible filler with joint sealer at the surface keeps moisture from entering at the joints.

The choice of ethylene glycol solution as the heating medium was based on its performance in previous installations. Some of these systems have given over 10 years' satisfactory service.

The solution is circulated through a steam supplied shell-and-tube converter. The converter and pumps are located in the building's main lower level equipment room, and the piping for the snow melting system extends along the basement ceiling. Takeoffs to the individual grids in the slab extend through the basement wall. Pipe grids are connected to the mains directly, rather than in the reverse return method. Each grid has a balancing cock to compensate for variations in main head loss as well as individual grid head loss.

Wall Creates Drift Problem

The retaining wall presented a snow drifting problem. To increase the melting rate in this area, the pipes were spaced 6 in. on centers after estimating the depths of the drifts. An arrangement of double headers was incorporated into the design which permits operation of the area using the pipe grids on 12 in. centers or the grids with the 6 in. center spacing.

This is accomplished by positioning a control valve to achieve the desired results. Another control valve cuts off circulation to the remaining area so that extended operation of the drifted area does not penalize the entire system.

The system is controlled manually from the engineer's office. Mounted on a control panel — which includes fan switches, warning devices, temperature indicators, and recorders for other mechanical equipment in the building — are an on-off pump switch, a high-low temperature switch, and two area selection switches for the snow melting system.

Control Solution's Temperature

The temperature of the heating medium is controlled by automatic modulation of a steam valve in response to either of two discharge thermostats. The thermostat in control is selected at the high-low temperature switch. Low temperature selection is used during periods of threatening weather so that response will be fast when it is needed most.

Past experience with automatic devices to anticipate conditions likely for snow have not been gratifying. Also, startup of a cold system by an automatic detector when snow is already falling would be too late in this particular installation since its existence is justified by the elimination of the *possibility* of a slippery driveway.

The two area selection switches control the open and closed positions of valves in the fluid lines. As mentioned previously, one valve on opening allows the operation of the grids with 6 in. spacing in the drifting area and the other shuts off the flow to the rest of the slab when just the drifting area requires melting. ±

Shipboard Air Conditioning Design Is Based on Unusual Considerations

BY LEWIS SMITH
Heating Engineer

THE DESIGN of air conditioning for sea-going vessels follows the same basic fundamentals that are used for cooling most large buildings on land. However, since a ship is a mobile structure, it is influenced by factors and conditions not encountered on land. In fact, trends are in progress today which may affect this phase of the industry extensively.

Adopted at first as a luxury item to make passengers more comfortable, air conditioning is now being extended to crews' quarters of purely cargo ships. Today, all new passenger liners are being air conditioned throughout at the design stage. It shouldn't be too long before the same can be said about freighters and tankers. The day of "glory hole" crews' quarters is past. A mock-up, built under the auspices of the Maritime Administration, makes the crew cabins of tomorrow look the equal of a first-class stateroom of 30 years ago. And they will include controlled air conditioning.

Ventilation has always been a shipboard necessity. At first applied only to spaces like engine rooms, galleys, and other hot spaces, it was extended to passenger quarters, especially to inside staterooms (which, incidentally, had gone out of fashion entirely until air conditioning brought them back again).

Until recently no mechanical attempt was made to cool staterooms. The outside temperature satisfied the "rugged" traveler of earlier days. He expected to rough it. But, with the advent of the "tourist" and "cruise," we have people who expect and demand comfort — they have become accustomed to living and working in air conditioned spaces. Air conditioning therefore is becoming almost as universal on the sea as on land.

The need for air conditioning of staterooms becomes all the more important when it is realized that most of these rooms have only a porthole or at best, if on the upper decks, a small window on one side with little if any chance for ventilation by natural means. On the other hand most of the public spaces on ship board present no special problem for the designing engineer and can be taken care of by the conventional means used on land. Therefore the principal interest lies in the means adopted for air conditioning staterooms.

Marine and shipyard engineers, being well acquainted with various duct systems for ventilation, have found it easy to adapt these ducts for cooling as well. In order to use a minimum of space, the terminal reheat system, shown in Fig. 1 on page 116, was the easiest to use and un-

● No longer merely a passenger liner luxury item, shipboard air conditioning today is extending to purely cargo ships as well. As a result, comfort cooling is becoming almost as universal at sea as it is on land. But certain factors—such as the mobility of the craft, the humid salt air, watertight bulkheads, the small size of staterooms, special ventilation requirements, and lack of duct space—present special design considerations. The author, Lewis Smith, describes the two most commonly used systems which best satisfy these problems.

Mr. Smith, a frequent contributor to Heating, Piping & Air Conditioning, has had many years in the heating and air conditioning field. Included in his broad experience is the development of heating systems which have been adopted by many apartment house projects in New York City and elsewhere.

AIR CONDITIONED throughout, Grace Line's new Santa Rosa is built for warm weather cruising in the Caribbean. Staterooms are maintained at 76 F DB, 63 F WB. Public spaces have low velocity systems with humidity control

til recently has been the most popular system used for passenger ships in American yards. Reheat coils (steam or hot water) are hung in the ceiling in each stateroom, usually over the toilet or lavatory.

This system is easy to install, is flexible in operation, provides individual room control to compensate for changing conditions due to ship orientation, and uses a minimum of equipment to be maintained and cleaned. Fully automatic control is easily obtained by the use of a room thermostat which operates a valve on the coil.

But it has disadvantages, too. Operating costs are high. Duct sizes, usually figured on the basis of 2000 fpm maximum velocity, are large. With recent developments in the use of smaller ducts with much higher velocities, this system may soon be superseded, at least for staterooms.

Outline Design Considerations

Before discussing this point, let's outline some of the factors which influence design. As said before, while the basic design is the same as for land installations, there are several factors encountered on the sea and in ships which make the practical application quite different:

1) A ship is not stationary like a building. Instead, it may face in any direction and travel on any of the seven seas—on the Indian Ocean in air that is 100 F dry bulb and 90 F wet bulb, or in the north Atlantic where air temperatures may be down near zero. A ship creates its own wind. Therefore all calculations have to be figured at their maximum. Zoning for exposure is impossible.

2) The outside air is more humid and is impregnated with salt. The generally used design condition outdoors is 95 F DB and 82 F WB, with indoor design in the staterooms being usually the same as on land (some engineers call for 76 F DB and 63 F WB). Due to the damaging effect of salt air, tubes and fins of coils are specified to be copper, with tubes to have walls 0.035 in. thick and fins 0.012 in. thick. Fins should be spaced no closer than $\frac{1}{8}$ in. apart, to keep them from collecting water. Fans and ducts are galvanized steel.

3) All ships have watertight bulkheads extending above the water line. These may obstruct running ducts on some lower decks. This, together with the elongated shape of a ship, results in breaking up the air conditioning system into more sections or zones than would be used on land.

4) Staterooms, designed and used largely for sleeping only, are smaller than most hotel rooms and may sometimes be occupied by three or even four persons. This requires more ventilation and increases the body heat gain. Even a small stateroom measuring only 100 sq ft may need $\frac{1}{2}$ ton of refrigeration. Low head room complicates diffuser design and location to avoid uncomfortable drafts.

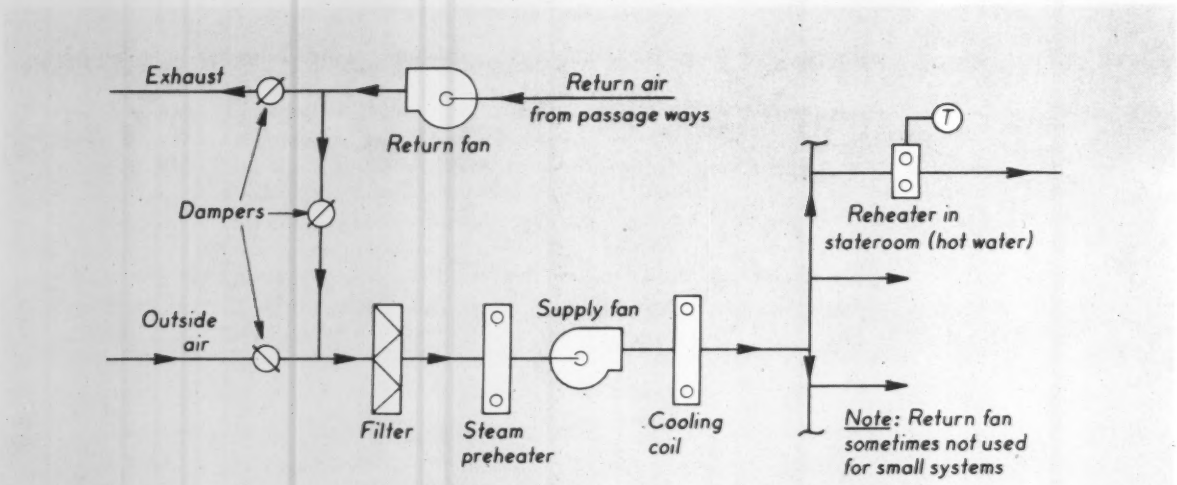
5) Because of the heat generated in engine rooms, galleys, etc., these spaces have heavily insulated interior walls and a high rate of ventilation, drawing in most cases part of this air from the interior of the ship through passageways to minimize the heat loss to the conditioned spaces.

6) If consulting engineers designing land installations groan over the lack of space allowed to locate their equipment, marine engineers have good reason to groan a hundred times as loudly. This has particular reference to ducts. Space was already at a premium before air conditioning was introduced. The need for minimizing duct sizes is giving rise to the use of higher terminal temperature differentials and much higher velocities — up to 4500 fpm (in some cases up to 6000 fpm), with fan static pressures up to 10 in. water gage.

Difficult to Install Insulation

The confined space through which several trades must run piping and conduit has led to difficulties in getting duct insulation properly installed, and, once installed, having it survive work by the other trades without damage.

One engineering firm has experienced so much trouble from condensation on bare spots that the scheme is being tried, when induction units are used in staterooms with chilled water coils, of reheating the primary



1 TERMINAL REHEAT SYSTEM, until recently most frequently used method for air conditioning ships, is easy to install, is flexible in operation, provides individual room control for changing conditions, uses minimum of equipment. But operating costs are high, duct sizes are large for available space

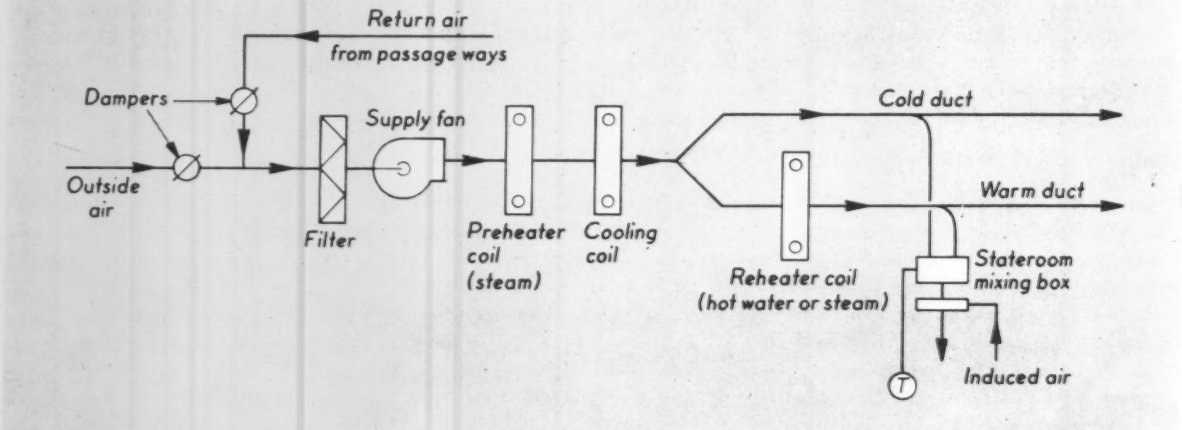
air at the fan room to 70 F. This makes it possible to eliminate insulation entirely. Obviously the cooling load and equipment are increased, but this is thought by this firm to be less of a drawback than defective insulation.

It might be thought that, where the exposed surfaces are of steel construction, the heat gain would be excessive. This doesn't prove to be true. These surfaces are well insulated, usually with 2 in. of glass fiber or the equivalent, and, with the extremely small glass areas in staterooms, the heat gain is comparable to land installations.

Fan-coil units have had little application in staterooms because it is impossible to have outdoor air openings through the hull at each unit. An outdoor air duct system would be required which might just as well be used for conditioned air — eliminating the need for fans in the room units and also the electrical wiring which is more costly on shipboard than on land. However, in the opinion of one qualified marine engineer, these units are "a satisfactory low cost method for air conditioning ships."

Induction System Popular

Another system often used is the familiar conduit system with induction units in each stateroom. Its application on ships is practically



2 DUAL DUCT SYSTEM, growing in popularity, features air velocities up to 6000 fpm, with consequent saving in space through use of small piping. With high static pressure (up to 10 in. WG) at fans, air flow is induced by specially designed diffusers. Chilled air (at lower than normal temperatures) is mixed with room air to maintain desired conditions, thereby reducing quantity of chilled air needed

identical as on land, except that there is a tendency to use higher air velocities (up to 4000 fpm).

On shipboard the extra power required is not as important as duct sizes, but the total power consumption is less than for the reheat system since only the primary air is handled by the fans and the cooling load drops off as the internal load falls. This is not the case with the reheat system. With these favorable factors, this system has now become popular on shipboard.

Dual Duct System Gaining

A type of dual duct system, shown schematically in Fig. 2, has recently been introduced. It is characterized by air velocities up to 6000 fpm in small round pipes, with up to 10 in. WG static pressures at the fans, and is designed for constant total air volume.

With the relatively high static pressure maintained at the mixing boxes in each stateroom, a flow of room air is induced by specially designed diffusers. Mixture of room air permits the use of lower temperatures in the cold duct, at the same time keeping the temperature of the air introduced into the staterooms at a satisfactory level. Lower cold air temperature means lower air flow volume. This is reflected by the motor horsepower for driving the fans, which is not increased to the extent that might be assumed from the high duct velocities.

The mixing boxes, usually hung in the ceiling, are designed to damp out any velocity noise from the ducts and can be operated from room thermostats. Since this is an all-air system, means must be provided to handle the return air through the passageways. A return air fan usually is not required. On some freighters 100 percent outdoor air may be used for the relatively small crew quarters.

Uses Small Ducts, Fittings

One of the features of this system is the use of small prefabricated duct distribution systems. The straight runs are made of No. 16 galvanized sheet steel in the smallest 2½ in. size, and No. 14 sheet in the largest size of 5½ in. Fittings are cast aluminum.

Butt joints are used and are easily secured with a special clamp lined with packing made in such a way that it forms a gasket at the joint. This clamp seals against leakage and provides the necessary structural strength.

Due to their small sizes, more ducts are used. However, less head room is required in the passageways. Prefabricated insulation may be used to save labor.

The Maritime Administration has proposed standard cabins for crews and officers on cargo ships. These will be served by this dual duct system. In the typical officer's cabin, conditioned air enters through a perforated ceiling panel 4 ft square.

In the crew cabin, air enters through a 5 ft long slot with an induction diffuser over the porthole. An adjustable louver at the head of each of the two bunks ejects a small stream of air over the occupant. The louver can be swivelled in any direction or the air can be shut off entirely, as the occupant may desire. A pneumatic control system with room thermostats operates the dampers in the mixing boxes to control room temperatures. The system has been installed on a number of freighters and is said to be noiseless, in spite of the high velocities used.

Today's Ships Put to the Test

Among the newest luxury passenger liners, commissioned in 1958, are the "Brazil" and "Argentina" of the Moore-McCormack line and the "Santa Rosa" and "Santa Paula" of the Grace Line. These ships make Caribbean and South American runs and therefore experience every kind of climate on each trip. All have terminal re-heat systems for staterooms. (In this connection it must be remembered that it takes three to four years from the design stage to the final commissioning of a ship this large. Therefore these specifications, having been written in 1954 and 1955, may not reflect the thinking of the same engineers and owners in 1959.)

All four ships are fully air conditioned throughout. Public spaces — dining rooms, cafes, bars, and hospitals — have separate low velocity duct systems with humidity control.

The Brazil, 617 ft long with an 81 ft beam, can carry a maximum of 553 passengers in its 182 staterooms, although the maximum passenger list so far has been 425. Air conditioned crew quarters have accommodations for 175. So altogether, there may be 900 people on board to take care of. This load is met by two centrifugal motor driven compressors rated at 325 tons of refrigeration capacity each.

Specifications for the Santa Rosa and Santa Paula called for two centrifugal compressors, each rated at 300 tons and using Refrigerant No. 11. They are driven by 350 hp motors and rated on sea water at a maximum of 88 F for the condensers which have ⅝ in. copper nickel alloy tubes with 0.065 in. wall thickness. Water chillers will cool 650 gpm from 52 F to 41 F.

Minimum outdoor air per person is 12½ cfm in staterooms and 15 cfm elsewhere, with the total volume per person running from 50 to 60 cfm. Reheaters for staterooms use hot water on a single pipe circuit, with 200 F entering water and a 10 F drop in winter. Reheaters in public spaces having humidity control use steam. Design temperature of the air leaving the cooling coils in the fan rooms is 51 F.

Staterooms are kept at 76 F DB and 63 F WB in summer, with 95 F DB and 82 F WB outdoors. Heating is based on 75 F indoors at zero F outside. On the cooling cycle, when the outside air temperature reaches 85 F, only the minimum outdoor air is required, increasing to 100 percent at 60 F outside. Each stateroom has a pneumatic thermostat controlling a throttling valve on the reheater coil.

Ducts are specified to be hot dipped galvanized copper bearing steel and duct velocity is limited to 2000 fpm. All exterior surfaces have 2 in. mineral wool insulation, while bulkheads around hot interior surfaces have 4 to 6 in. of insulation. ≠

Now's the Time to Brush Up on Your Hot Water Heating Fundamentals

Heating, Piping & Air Conditioning continues its digest of design and installation principles for hot water heating systems. F. F. Stevenson, an authority with many years' experience in the heating field, turns his attention to the correct application of steam converters.

BY F. F. STEVENSON
Design Engineer

As STATED last month, for all divisions of hot water heating the water temperature may be raised in a hot water boiler or a converter.

Converters nearly always use steam in the shell and water in the tubes and are furnished with the tubing arranged for two or four water passes. The four-pass converter is commonly used for smaller quantities of water and the two-pass for larger flows. The heat must be transferred through be external film, from steam to the external surface of the tubes, and the internal film, from the internal surface of the tubes to the water. Resistance of the copper tube walls is so low that it is ignored.

The external heat transfer coefficient varies with the amount of condensate produced per square foot of external tube area. The greater the amount of condensate lying in the shell before being drained by the trap, the lesser the amount of tube surface exposed to the steam and the lower the heat transfer rate. For average work, the external film coefficient varies from 1600 to 2000 Btu per sq ft per F temperature difference per hr. These figures are for approximately 13 to 35 lb of condensate per sq ft of tube surface per hr.

These values are subject to the correction of three factors:

1) *Temperature.* This refers to the mean average temperature of steam and water combined. These values in average low pressure jobs range from 190 F to 250 F and the factor varies from 1.40 to 1.65.

2) *Tube size.* The factor for $\frac{5}{8}$ in. tubes is 1.17; for $\frac{3}{4}$ in. tubes, 1.11; and for 1 in. tubes, 1.00.

3) *Diameter of shell.* This factor allows for positioning the tubes in the shell with respect to height. Condensate drips down from the upper tubes and impinges on the lower. The film of water on the tubes impedes the heat transfer and, if the tube bundle is high, many tubes are affected. These factors are all minus. The smaller the diameter of the shell (lower height), the closer the factor approaches unity.

Shell diam, in.	Factor
4	0.70
6	0.65
8	0.55
10	0.50
12	0.48
14	0.46
16	0.44

Steam quality (moisture percentage) and the presence of air in the steam are also factors which reduce heat transfer. It is difficult to reduce the value of these losses to actual figures, but if steam is wet or if air is present, a safety factor should be applied.

Internal heat transfer coefficient varies with tube size (small tubes increase this factor), water flow rate, and water temperature.

The higher the velocity and temperature, the greater the transfer.

Average values for low pressure heating work range from 1000 to 1600 Btu per hr. These figures are for clean tubes. A scaling factor must be used, since hot water precipitates the solids in water much faster than cold. For moderate water hardness a resistance factor of 0.001 may be taken. For very hard water this factor may be up to 0.05. This would give heat transfer values of 1000 to 2000 Btu.

Compute Transfer Coefficient

Let's compute the overall heat transfer coefficient, U, for a hot water converter 10 in. in diameter, with $\frac{3}{4}$ in. copper tubes. Suppose steam, at 10 psig and 239.5 F, is available at the shell (after the modulating valve) and the design water inlet temperature is 190 F and the outlet temperature is 210 F. Assume 22 lb of condensate per sq ft of tube area per hr, a water velocity in the tubes of 2 fps, and a mean steam-water temperature of 200 F. The external film coefficient is:

$1750 \times 1.47 \times 1.10 \times 0.50 = 1415$

The internal film coefficient is taken as 1250 Btu and the ratio of external surface of tubes to internal is 1.11. The scaling coefficient is assumed to be 1000 Btu.

$U = 1/[(1/1415 + 1.11/1250 + 1/1000)] = 400$ Btu per sq ft per F temperature drop per hr.

The mean temperature difference is found to be 45 F, so the total heat transfer from the condensing steam in the shell to the water flowing in the tubes will be:

$400 \times 45 = 18{,}000$ Btu per sq ft per hr

In order to check the relationship of condensate per square foot of tube surface, we compute the pounds of steam at design pressure by the following:

18,000/942 = 19.2 lb of steam per sq ft per hr

This corresponds fairly closely to our assumed figure of 22 lb. A smaller diameter shell, larger tubes, and higher water velocity through the tubes would increase the value of U as found in above equation. Elimination of the scale factor will result in a greater U coefficient, about 625 Btu.

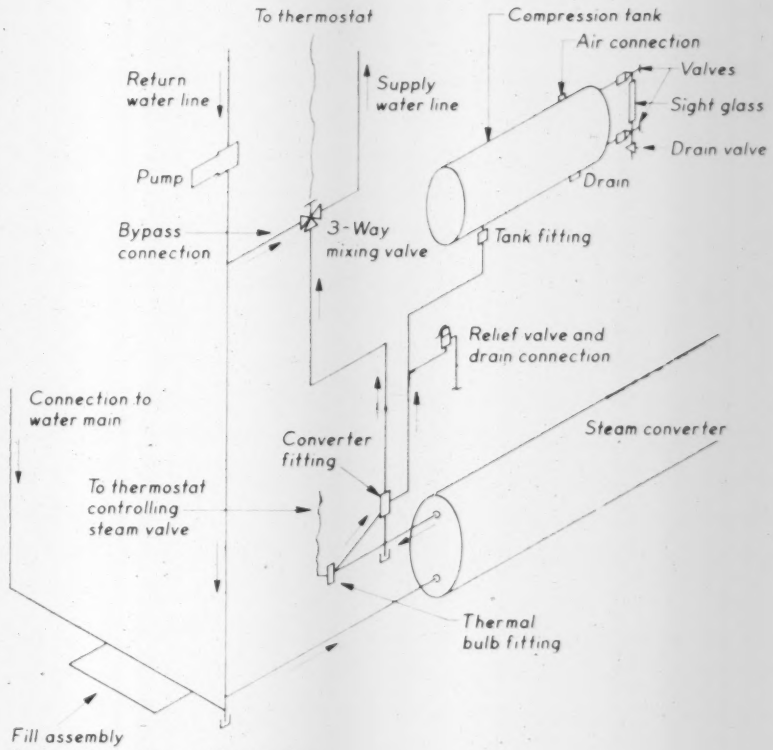
If the engineer neglects the scale factor, the heat transfer of the converter will fall off alarmingly when scale begins to form on the tubes. Remember, the above heat transfer figure is based on high quality steam with a minimum of air. Note that the heat flow from steam in a hot water converter is much greater than from steam in a blast coil to air. But the temperature difference in the converter is considerably less.

For this reason, converters may be supplied by lines carrying 40 or 50 psig steam. With such pressure steam and a modulating valve, a pressure drop of, say, 60 percent of line pressure can be taken through the valve. This will give the valve good flow characteristics and still supply steam to the shell at a high temperature.

With steam pressure steady, a linear flow characteristic valve (v-port or contoured plug) can be used with good results. If a quicker response is desired at high conditions, or if the steam pressure may vary, an equal percentage valve can be installed.

Two kinds of control can be used on the steam supply to the converter: a two-position valve giving either 100 percent steam supply or none at all, or a modulating valve, as noted above. The two-position valve will cycle more often and will not give the close control of the gradual acting valve.

However, the latter valve may cause trouble when throttled, because of a low heating load — especially with converters of the instantaneous type. Under these conditions, very little steam is admitted to the shell. This is quickly condensed, creating a vacuum. Condensate which has not yet been drained from the shell through the trap will flash into steam causing severe surges and water hammer, sometimes enough to rupture the shell.



CONVERTER, TANK, BYPASS connections illustrated above. Note that tank is on discharge side of pump. This is all right when pump head is *below* gravity head of system. Pump discharges *into* converter

To avoid these dangers, it is best to drain the condensate through an open gravity return line. The trap should be capable of removing the design flow of condensate quickly and without water logging in the converter shell. A float trap with a thermal air vent is best with a modulating valve, or an air vent bypass line may be substituted for the vent in the trap. The flow of air in the bypass can be controlled by a small sensitive thermostatic trap capable of passing air at 5 or 6 F below normal condensate temperature and closing when temperature rises to design.

A float trap with a modulating steam valve passes water constantly and establishes an equilibrium of flow with the valve. It should not be used, however, when there are risers in the return line. To avoid water logging in the shell on low loads, the return line should have no risers and should flow by gravity to a vented receiver.

Some hot wells and deaerators are vented also. A vertical return leg out of the converter, extending a foot or so below the level of the condensate outlet, will give the increased head necessary on low loads to afford a good pressure drop across the trap and stimulate drainage.

Need Vacuum Breaker

A vacuum breaker is essential when the converter, especially the instantaneous type, is operating with a heavily throttled valve. The following arrangement is often used: Run a small line from the steam main at the inlet of the converter to the vented receiver. At a point adjacent to the converter, connect an open end vertical pipe leg to this line. Place a check valve in the line between the vent leg and steam inlet. This valve will close to steam pressure, but, when a vacuum exists in converter, it will open.

admitting atmospheric pressure to steam inlet.

Valve Keeps System Filled

The modern closed hot water heating system is kept filled by the use of a pressure reducing valve, open to the building water supply line. The pressure setting of the PRV must be synchronized with the system pressure, i.e., the head of the system developed by the cushion of air in the compression tank when the water is heated.

If the PRV is set too high, the system pressure becomes greater than needed. If set too low, the system will not be supplied with water until its pressure is below operating design. The nominal setting for these valves is 12 psig. This corresponds to about 30 ft head, enough for an average three-story system. Pressure settings are adjustable and a high pressure PRV is available.

The relief valve must also be synchronized with the system pressure. If the setting is too low, the valve will pop before it should and waste water. If too high, undue stress may be set up in the system.

The valve must operate against an atmospheric pressure of 14.7 psia. This means the system pressure must be used. A rule of thumb is to set the valve for a gage pressure equal to the absolute pressure of the system, plus 10 lb. For example, in a system with pressure of 10 psia, the gage setting of the relief valve should be 10 + 10 + 14.7, or 35.3 psig.

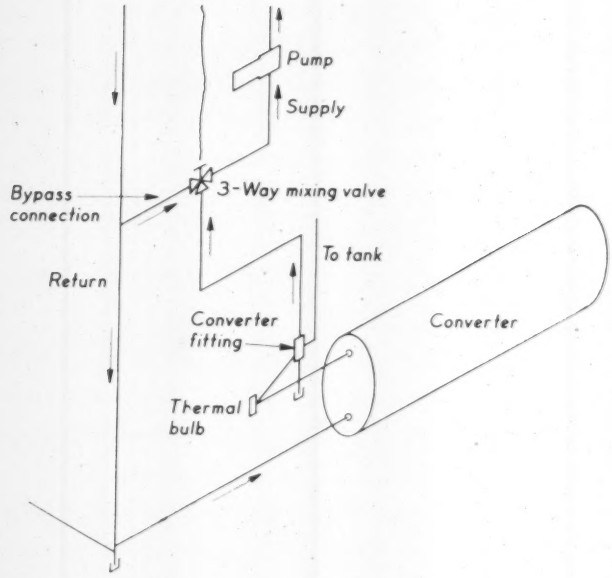
The correlation of the compression tank connection to the system in relation to the location of the pump is interesting. With a closed circuit compression type of hot water system, there are two pressures which affect the water in the piping:

1) The static head furnished by the air in the compression tank, sufficient to push the water up to the highest point in the circuit. This may be called the system pressure.

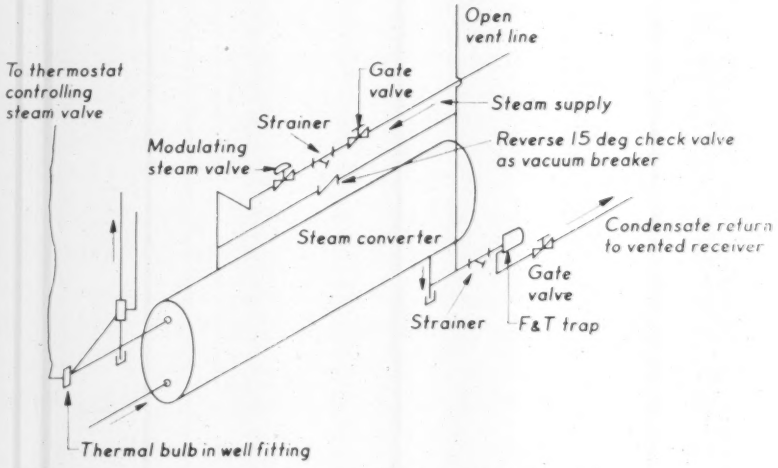
2) The pump head which serves to create a flow through the circuit, overcoming the resistance offered by the pipe, fittings, valves, etc.

With the pump stopped, the only pressure in the system is the static head. But when it is started, pressure changes occur. The pump will develop sufficient pressure difference across itself to create a flow and overcome the circuit resistance. As stated before, this is the pump head and the pressure at the pump discharge will be higher than the pressure at the pump suction by this amount.

The point in the system where the tank is connected to the main is called, by one authority, the point of no pressure change. At this point, the system pressure does not change, whether the pump is running or not.



IN THIS DRAWING, tank is on suction side of pump. Pump head of system is higher than gravity head. Pump pulls *out of* convertor



STEAM CONNECTIONS to converter may be made as shown here

Checking Pressure Difference

The pressure difference created by the pump may be checked as follows: Assume a system serving a two-story building, with the second floor circuit running just above the floor level and the converter 4 ft above the basement floor. The static head of such a circuit will be approximately 20 ft

(vertical distance from converter to second floor circuit). Assume the loss through the piping circuit is 12 ft. The tank is connected to the system on the suction side of pump. With this hookup, pressure changes caused by pump operation are made on the discharge side of pump, because pressures do not change on the suction side. Therefore the pressure is increased at the pump outlet by 12 ft. The pressure difference across the pump might be expressed by:

(20 + 12) − (20 − 0) = 20 + 12 − 20 + 0 = 32 − 20 = 12 ft.

Note that the pressure is positive at pump discharge and follows a constantly diminishing curve as the water flows around the circuit. At the pump intake, the pressure difference it has developed has been totally expended in overcoming the resistance of the piping, and the pressure is equal only to the static head.

What happens when the tank is connected to the main on the discharge side of the pump? The point of no pressure change is now at the pump outlet. But there must be the same pressure difference across the pump to create flow. With the tank located at the pump discharge, pressure changes created by pump operation must be on the suction side. The pump difference might be expressed by:

(20 − 0) − (20 − 12) = 20 − 0 − 20 + 12 = 20 − 32 = −12 ft.

Now we have a zero pump head at the pump discharge and a negative pump head of 12 ft at the suction intake. All the work of overcoming resistance is done by the difference between zero ft at the pump discharge and − 12 ft at the pump suction, and the entire circuit is under a negative head.

If the tank is connected to the main midway in the circuit, still another situation exists. Assume the resistance of the piping is evenly divided around the circuit. Then the resistance up to the midway point is 6 ft and the pressure change at this point is zero. So the pump discharge pressure difference will be:

(20 + 6) − (20 − 0) = 20 + 6 − 20 − 0 = 6 ft.

The pressure difference at the pump suction is determined by:

(20 − 0) − (20 − 6) = 20 − 0 − 20 + 6 = −6 ft.

Note here that the first half of the system is under positive pressure and the second half under negative.

A hot water heating system having a high pump head should not use negative pressure at the pump suction to "pull" the water around the circuit. A high pumping head system is one in which the pressure difference developed by the pump is greater than the gravity head of the system. When a negative pressure is used in a high pump head circuit, the water at the intake of the pump may boil, circulation may be unstable, and pump cavitation may result.

When the pressure in a system drops below atmospheric, air may be taken in through the vents, air pockets may be created, and the circulation may be impeded. Also, it may be impossible to accomplish the initial air venting of the system.

As stated, the above only applies when the pump head is greater than the system head. This does not occur, however, in too many systems. When the system head is greater than the pump head, the pump pressure differences developed are low enough so the relationship of the pump and tank is not too important.

However, placing the tank connection on the suction side of the pump is a good location for all around efficiency. In this case, the pump is placed on the discharge line from the converter, and water is pumped out of converter instead of into it. Some engineers prefer to locate the pump on the return line pumping into the converter. If pressure conditions do not dictate the location of the tank on the suction side of pump, you may take your choice.

3 Temperature Control Sources

A hot water system may have three sources of temperature control:

1) Outdoor temperature, with a master thermostat.

2) General zone or area temperature, with a space thermostat.

3) Individual control of radiators or convectors, either by a self-contained temperature regulating valve or manual manipulation of a hand valve.

Night control can be obtained by means of a night thermostat placed in the circuit with a time switch. In mild weather, the pump may be shut off for considerable periods at night through a connection with the thermostat. If the temperature control is stopping the pump for considerable periods of time, a time relay may be hooked into the time switch to operate the pump for a few minutes every half-hour. This to avoid stagnation in the lines. Stopping of the pump at night may cause air venting the system in places where venting may not be too good while pump is running.

Outdoor temperature control is used alone on many one-zone systems, and also used with zone control on zoned systems. It controls the temperature of the water leaving the converter, so that a constant ratio is established between that and the outside temperature. This can be done by:

1) A modulating steam control valve, controlled by a submaster thermostat with its bulb located in the water outlet. The submaster is automatically reset by a master thermostat with a remote bulb sensing outdoor temperature.

2) A three-way mixing valve to mix supply and return water to obtain the required temperature called for by the submaster and master thermostat combination. With this second control, the water from the converter is held at a constant temperature by a self-contained temperature regulating valve with its remote bulb in the converter water discharge.

Zone temperature control systems are usually handled by a space thermostat actuating a three-way mixing valve working in conjunction with an outdoor control.

Individual control of offices and similar spaces is usually obtained through a self-contained temperature regulating valve at the radiator or convector or by a hand valve.

Multi-zone control will be discussed in a future article. ‡

Some of the data used in the discussion of tank location was obtained from literature prepared by Bell & Gossett Co.

Calculating Contraction Stresses

● Last month K. Hao Hsiao presented a comparison of two different procedures for calculating piping stress and showed the results obtained from both to be in very close agreement. He continues his discussion here, showing how to calculate contraction stresses for piping systems handling liquid oxygen and liquid nitrogen. Again he compares the results from his procedure with those derived by use of the Kellogg method.

The author has both BA and MA degrees from Stanford University. Following graduation he was employed in the mechanical engineering department of Ohio State University. He later worked with Aluminium, Ltd. in Montreal and with Canadair, Ltd. as a stress engineer in the same city. Before joining Holmes & Narver he was also with Stadler, Hurter & Co., consulting engineers. In his article, *Calculating Pipe Stress Efficiently*, published in three parts in the September and December 1957 and January 1958 issues, Mr. Hsiao developed a tabular procedure for the efficient and time-saving calculation of forces, moments, and stresses due to thermal expansion of piping systems.

BY K. HAO HSIAO
Holmes & Narver, Inc.
Engineers-Contractors

TABLE 1 — COEFFICIENTS for force equations used in deriving force and moment ranges in Table 2 are calculated below

	Designation	X	Y	L^2	L	Ly	Ly^2	Lx	Lx^2	Lxy
ELBOWS	a b	L_a = 6.2				6.48	42.0	6.02	36.20	+39.00
	c d					6.48	42.0	-.19	.04	+1.23
	e f					.19	.04	-.19	.04	-.04
(1)	SUM				Σ	13.15	84.04	6.02	36.28	40.19
(2)	KL_a * (1)					68.70	604.00	47.50	286.50	317.00
Y BRANCHES	a c	0	+3.54	180	13.65	18.90	63.00	0	0	0
	SUM			I_y 180						
X BRANCHES	b c	3.10	6.67	40	7.19	34.60	230.00	16.10	49.8	107.20
	f g	-1.54	0	4.65	1.66	0	0	-2.24	3.0	0
	SUM			I_x 44.65						
(3)	SUM*				16.31	53.50	293.00	13.86	52.80	107.20
		(4)	Σ (2)+(3)		36.21	137.50	357.00	61.36	339.30	424.20
		(5)	(4) ÷ ΣL		$\bar{Y}$ = -2.36		$\bar{X}$ = +1.70			
		(6)	(5) x Σ		$\bar{Y}\Sigma Ly$ = 685.0		$\bar{X}\Sigma Lx$ = 104.0		$\bar{Y}\Sigma Lx$ = 267	
		(7)	(4) - (6)		$I'x$ = 272.0		$I'y$ = 235.30		I_{xy} = 157.20	
		(8)			$I_{z/2}$ = 15.0		$I_{y/2}$ = 12.0			
			(7)+(8)		I_x = 287.0		I_y = 247.40			

LINE DATA (4")
I = 2.80
S = 4.36
T = -320°F
e = 3.96 /100
E_c = 17.6 x 10^6
E_a = 16.6 x 10^6
KL_a = 7.90 R = 6⅛"
h = 0.167 K = 9.88
i = 2.97
Δx = .0396 x 8.38 = .33"
Δy = .0396 x 6.6 = .244"

$-\frac{I_{xy}}{I_x} = -.55$ $\frac{I_y}{I_{xy}} = 1.57$

$\frac{\Delta_x E_a I}{1728 I_x} = \frac{(.33)(16.6)(10^6)(2.8)}{1728(287)} = .31$

$\frac{\Delta_y E_a I}{1728 I_{xy}} = \frac{(.244)(16.6)(10^6)(2.8)}{1728(157.2)} = 4.7$

* SUM OF ALL BRANCHES

IN THE DESIGN of most piping systems, expansion is usually the prime stress consideration. Not so with today's rocket and missile piping, which is usually stainless steel but sometimes copper. These systems, containing liquid oxygen and liquid nitrogen, are handling fluids with temperatures well below zero F. Consequently, the stress consideration is one of contraction.

In calculating contraction stresses, the directions of forces at an anchor resisting contraction, and hence those of the original axes X, Y, and Z, must be opposite to those assumed for expansion.

Analyze —320 F System

The following is an analysis of a single-plane system of 4 in. liquid nitrogen piping in hard-drawn copper operating at —320 F. The process of calculation for force ranges, moment ranges, and maximum stress is given in Tables 1 and 2.

As shown in Table 1, the modulus, corresponding to E_c at installation temperature (for piping under expansion), is denoted by E_a for piping under contraction, where $_a$ repre-

in Missile Piping Systems

sents an ambient temperature of 70 F. Thus, the forces X and Y and moments from Table 2 are all ranges based on E_a, and the stress calculated is the controlling stress range. The numerical values of I_{xx}, I_{yy}, and I_{xxy} are negligible, so they are not included in the calculation of coefficients.

The directions of the X and Y axes in Table 1 are the same as those of X and Y forces resisting contraction at anchor a. The origins of these axes are placed at the intersection point of de and fg in order to reduce two coordinate values to zero while keep-

TABLE 2 — FORCE, MOMENT ranges for example liquid nitrogen system calculated. Maximum stress of 6500 psi is well within allowable range for hard-drawn copper

$X - .55Y = 31$

$-X + 1.57Y = 41.7$ $\quad X = 70.1 \quad Y = 71.2$

FROM TABLE *3 / FROM (5) of TABLE *3	POINT	a	b	c	d	e	f	g
	x	6.21	5.70	.51	0	0	- .51	- 2.17
	y	6.16	6.67	6.67	6.16	.51	0	0
$\bar{x} = 1.70$	$x - \bar{x}$	4.51	4.00	- 1.19	- 1.70	-1.70	-2.21	-3.87
$\bar{y} = 4.35$	$y - \bar{y}$	1.81	2.32	2.32	1.81	- 3.84	- 4.35	- 4.35
(1)	$X(y-\bar{y})$	127.0	162.5	162.5	127.0	-269.0	-305.0	-305.0
(2)	$Y(x-\bar{x})$	321.0	285.0	- 84.7	-121.0	-121.0	-157.5	-275.0
(1)-(2)	M_{xy}	-194.0	-122.5	247.2	248.0	-148.0	-147.5	- 30.0

Max. Stress $S_e = S_b = \frac{248(12)2.97}{1.36} = 6500$ psi (at "d")

*On page 109 in the September issue.

Nomenclature

L = length of each piping branch, ft

x, y, z = coordinates of the centroid of each piping branch or elbow with respect to the original arbitrarily chosen X, Y, and Z axes, ft

$\bar{x}, \bar{y}, \bar{z}$ = coordinates of the centroid of piping system with respect to the original arbitrarily chosen X, Y, and Z axes, ft

I_x, I_y, I_z = moments of inertia of the system about its centroidal axes, ft^3 (magnified 12 times)

I_{xy}, I_{xz}, I_{yz} = products of inertia of the system about its centroidal axes, ft^3

I_1 = centroidal moment of inertia of branches parallel to Z axis, ft^3 (magnified 12 times)

I_2 = centroidal moment of inertia of branches parallel to Y axis, ft^3

I_3 = centroidal moment of inertia of branches parallel to X axis, ft^3

I_{ox}, I_{oy}, I_{oz} = sums of centroidal moments of inertia of elbows about their own respective neutral axes, ft^3

m = number of elbows in planes parallel to the axis of I_o

n = number of elbows in planes perpendicular to the axis of I_o

$I_{oxy}, I_{oxz}, I_{oyz}$ = sums of centroidal products of inertia of elbows parallel to the plane of inertia, ft^3

$\Delta x, \Delta y, \Delta z$ = total thermal expansion of the system in the X, Y, and Z directions respectively, in.

E_h = modulus of elasticity of the piping material at operating temperature or in the hot condition, psi

E_c = modulus of elasticity at installation temperature or in the cold condition, psi

I = moment of inertia of the cross-sectional metal area of the pipe, in.^{4}

S = section modulus of pipe, in.^{3}

D = outside diameter of pipe, in.

t = thickness of pipe wall, in.

r = mean radius of pipe, in.

T = temperature, F

e = thermal expansion in 100 ft of pipe due to a rise from installation temperature to operating temperature, in. per 100 ft

R = radius of curvature of elbow or quarter bend, ft

X, Y, Z = forces due to expansion, lb

M_{xy}, M_{xz}, M_{yz} = bending moments due to X, Y, and Z forces in XY, XZ, and YZ planes (one of these moments is actually a torque) ft-lb

X', Y', Z' = relative force values

$M'_{xy}, M'_{xz}, M'_{yz}$ = relative moment values in XY, XZ, and YZ planes

M_d, M_d = relative and absolute values of combined bending moment at point d of the system, ft-lb

T'_d, T_d = relative and absolute values of torque at point d, ft-lb

h = characteristic factor

K = flexibility factor

L_a = actual length of elbow or quarter bend, or effective length of mitre bend, ft

i = stress intensification factor

a = transverse virtual length, ft

β = differential virtual length, ft

θ = one half angle between adjacent mitre axes, degrees

c = cold spring factor

X_h, X_c = values of X in hot and cold conditions, lb

s_b = maximum bending stress, psi

s_t = corresponding torsional stress, psi

s_a = allowable stress range, psi

f = stress range reduction factor. ($f = 1$ for 7000 or less temperature cycles over expected life of piping.)

(1) to (27) = numerals each representing one row of figures

A, B, C = symbols each representing one numerical value

(a), (b), (c) = symbols each representing three values A, B, and C

N = total number of elbows in a system

N_{xy} = number of elbows parallel to XY plane

ing the signs positive for most of the remaining coordinates.

An alternate placement would be to use the directions of resisting forces at anchor *g* for the axes and place their origin at the intersection of the vertical line through the centroid of *bc* and horizontal line through centroids of *ab* and *cd*, thereby reducing three coordinate values to zero.

The allowable stress for annealed copper at −20 F is 6700 psi, according to the Code. Hence, the maximum stress of 6500 psi from Table 2 is well within the allowable stress range for hard-drawn copper at −320 F, which is higher than 6700 psi. Therefore the system shown in Table 1 is safe. In this case, the use of allowable stress range is based on the phenomenon of "self-springing" as a result of plastic flow from localized yielding (not from creep, such as occurs at elevated temperatures).

It is to be noted that Type 304 stainless steel piping at −300 F has a smaller expansion rate, which can be computed from the mean coefficient of expansion, given in *Thermal Expansion Characteristics of Stainless Steels Between −300 F and 1000 F*, by D. E. Furman, International Nickel Co., *Journal of Metals*, April 1950, AIME Transactions, Vol. 188, p. 688.

In the September issue of this publication the author compared the results of his calculations of expansion stress with those obtained by the Kellogg method. A similar comparison, drawn for the nitrogen piping system discussed here, is given in Table 3 and indicates that the two sets of results are nearly identical. #

TABLE 3 — RESULTS of author's calculations are compared with those obtained by Kellogg method. Note close agreement

	Forces, lb		Moments, ft-lb, at							Controlling stress range, psi
	X	Y	*a*	*b*	*c*	*d*	*e*	*f*	*g*	
Range										
Author's	70.1	71.2	194	122.5	247.2	248	148	147.5	30	6500
Kellogg*			195	125	248	248	147	148	29	6484
At −320 F (multiplied by E_C/E_H)										
Author's	74	75	206						31.8	
Kellogg*	74	75	207						30	

*Results by the Kellogg method were computed on an IBM 650 computer through the courtesy of the Service Bureau Corp., Los Angeles.

Largest U. S. Heat Pump System Installed in New Printing Plant

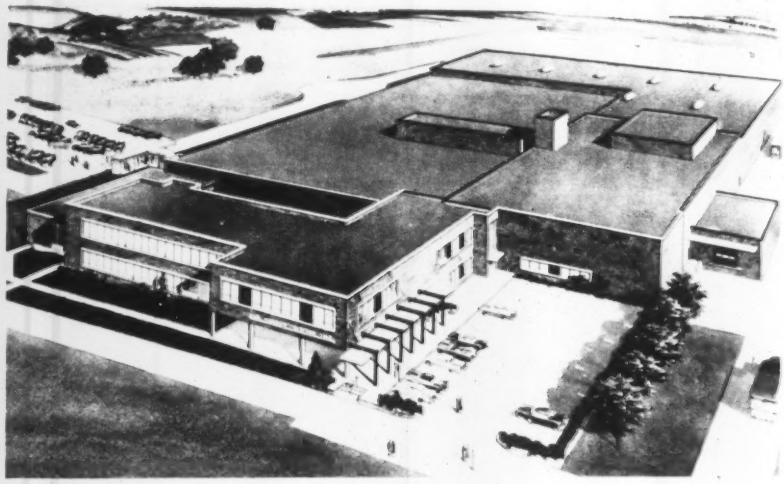
A NEW $5 million publishing house, now under construction in Huntington, Ind., will employ the largest heat pump system in the U. S. and possibly the world, according to Carrier Corp.

The new printing establishment of *Our Sunday Visitor*, most widely circulated Catholic newspaper in the nation, will be provided with three 500 hp water chilling machines which will supply the needs of 200,000 sq ft of office and printing plant area.

Five major advantages of this heat pump installation are:

1) Equipment required is reduced by 50 percent.
2) One-half the space at $10 per sq ft is saved.
3) Absence of fuel storage.
4) Fire insurance rates are reduced.
5) Maintenance costs are lowered.

F. A. Fink, managing editor of *Our Sunday Visitor*, observed that, "Maintaining constant temperature and humidity is essential to fine printing operations."



The two-story office and windowless plant is expected to be ready for occupancy by January 1961.

Pipe Welding Terms Defined

BY HELMUT THIELSCH
Metallurgical Engineer
Industrial Piping Div.
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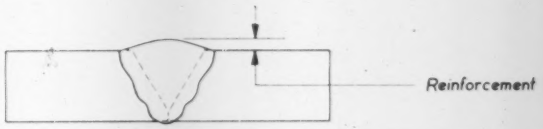
This is a continuation of a listing of pipe welding terms and their definitions. Earlier listings appeared in the November and December 1958 Data Sheets.

Reinforcement weld: Weld metal on the face of a groove weld in excess of the metal necessary for the specified weld size.

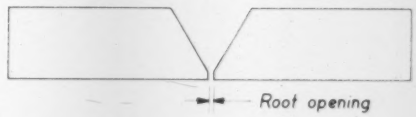


Root face: That portion of the groove face adjacent to the root of the joint.

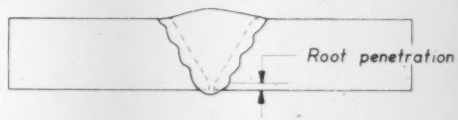
Root of joint: That portion of a joint to be welded where the members approach closest to each other. In cross-section, the root of the joint may be either a point, a line, or an area.

Root of weld: The points, as shown in cross-section, at which the bottom of the weld intersects the base metal surfaces.

Root opening: The separation between the members to be joined, at the root of the joint.



Root penetration: The depth a groove weld extends into the root of a joint measured on the center line of the root cross section. Welds made under the ASME Boiler and Pressure Vessel Code which show incomplete penetration are considered unacceptable.

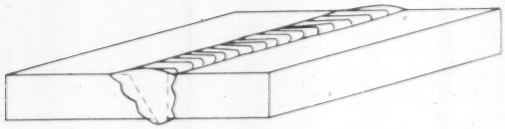


Seal weld: Any weld used primarily to obtain tightness, as used to seal the plugs on radiographic access holes.

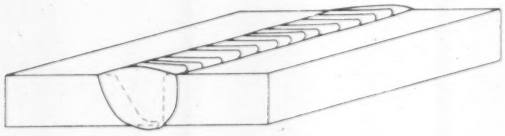
Semi-automatic arc welding: Arc welding with equipment which controls only the filler metal feed. The advance of the welding is manually controlled.

Shielded metal-arc welding: An arc welding process wherein coalescence is produced by heating with an electric arc between a covered metal electrode and the work. Shielding is obtained from decomposition of the electrode covering. Filler metal is obtained from the electrode.

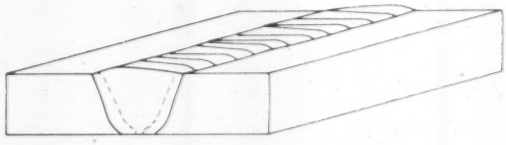
Single bevel groove weld: A type of groove weld.



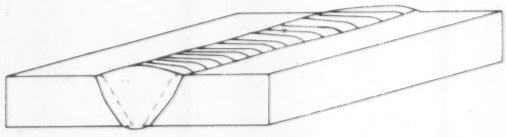
Single j-groove weld: A type of groove weld.



Single u-groove weld: A type of groove weld.

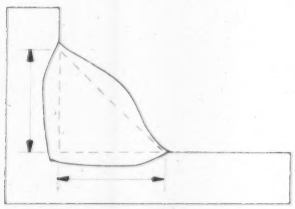


Single v-groove weld: A type of groove weld.

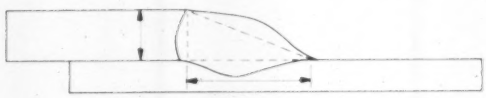


Size of weld: Groove weld—The joint penetration (depth of chamfering plus the root penetration when sepecificed).

Size of weld: Fillet weld—For equal leg fillet welds, the leg length of the largest isosceles right triangle which can be inscribed within the fillet weld cross-section.



For unequal leg fillet welds, the leg lengths of the largest right triangle which can be inscribed within the fillet weld cross-section.



Slag inclusion: Nonmetallic solid material entrapped in weld metal or between weld metal and base metal.

Spatter: In arc and gas welding, the metal particles expelled during welding and which do not form a part of the weld.

Spatter loss: Difference in weight between the amount of electrode deposited and the weight of the electrode consumed (melted).

More pipe welding terms will be defined and illustrated in early issues.

INDUSTRIAL VENTILATION:

Air-Starved Plants Can Breathe Easy Through Proper Makeup Ventilation

● **Wintry air leaking around windows, blowing down through roof ventilators, and blasting through open shipping doors—to somehow satisfy the wants of a building gasping for breath to replace the tremendous volumes of contaminated air that is exhausted to the outside—is a primary cause of discomfort in many industrial plants. The solution to this problem is found through makeup air ventilation systems which will deliver tempered supply air in sufficient volumes to compensate for the air that is removed. The author presents herein some of the basic considerations in the proper design of these systems.**

The author, a 1930 mechanical engineering graduate of North Carolina State College, was employed by Carrier Corp. as a district engineer in its Charlotte office from 1931 to 1939. Joining Alcoa in 1939 as a staff ventilation engineer, he has been responsible for heat relief and working conditions in the company's plants since 1944. From 1947 until the first of this year, Mr. Small was a member of the TAC on Industrial Environment for ASHAE. He was a member of the Preventative Engineering Committee of the Industrial Hygiene Foundation, Mellon Institute, from 1948 through 1953.

BY B. R. SMALL
Staff Ventilation Engineer
Aluminum Co. of America

TODAY'S higher standards for industrial hygiene and housekeeping have put new responsibilities on the shoulders of mechanical engineers—whether they be in the plant, in the consultant's office, or in sales.

The field of industrial ventilation is becoming a beehive of activity. More and better exhaust systems are required for the removal of odor, fog, fumes, dust and heat. It is obvious that all of this air must be replaced by some means, either by infiltration or by mechanical supply.

Ways and means for overcoming air supply deficiencies in industrial buildings during winter is the basic theme of this study. How to carry over the benefits to summer heat relief is a second objective.

Quite frequently a plant starts up a large new ventilation system, perhaps for vapor absorption in a bleachery or paper mill, or dust collecting in a furniture plant. Everyone is pleased with the results until the first severe cold spell strikes. Then the occupants discover that the building has become as cold and drafty as an old barn or tool shed. Cold air leaks in around windows, blows down through roof ventilator openings, and blasts in through open shipping doors.

With the impact of this cold spell, the plant people belatedly take up the subject of makeup air supply equipment. Such equipment involves an air heater with controls for a constant discharge air temperature, together with a fan and air distribution ducts sufficient to prevent drafts.

Ill-Ventilated Plant Buttoned-up Under Vacuum

An air-starved magnesium foundry during the feverish first days of World War II is an unforgettable example. This isolated building, about 100 × 400 ft, contained centrifugal exhaust fans of some 150,000 cfm, admittedly a powerful force, plus several large propeller fans. With this building buttoned-up for the first New England winter, a partial vacuum existed of some 0.2 in. water gage. Door traffic was nearly eliminated. When one slammed shut, it could cut off a leg. No provision was made for replacing the air which was taken away.

A fact frequently not realized today is that, in indus-

This article is based upon a talk given by the author before an industrial ventilation conference held recently at North Carolina State College.

trial plants, air supply is no longer a luxury, but is a necessity. Without it, many plants could not operate safely, even for a very short time. Without sufficient air, these exhaust systems fail to collect and to carry away objectionable and even dangerous matter.

When Do We Need Industrial Air Supply?

Truthfully, the cost of exhaust systems is not complete until the cost of equivalent makeup air is included. But when do we need this industrial air supply? As one runs the gamut of various industries, the elements to evaluate are:

1) Rate of air exhaust in terms of air changes per hour within the building

2) Layout and capacity of the heating system in the building

3) Building tightness or infiltration qualities

4) Character of product and quality of skills required.

The least need for industrial air supply is in large plants with connecting buildings. Here, each building can contribute some infiltration and still not overload the conventional heating system because the load is being spread among many unit heaters.

The greatest need exists in isolated single-building plants and in windowless buildings.

Design for Year 'Round Utility

The field of makeup air has many facets. Don't limit your design to winter air supply benefits only. Rather, offer a summer-winter combination. The more ways a system can be useful in a plant, the more value contributed and the greater the return on the investment.

The various services these systems can perform come under two main categories[1]:

1) Control of space conditions

a) Temperature and humidity control

b) Contaminant control

c) Summer outdoor air circulation

2) Winter air supply

An example of a makeup air installation that has capitalized on summer-winter double-duty benefits is Aluminum Company of America's screw machine facility at Lancaster, Pa. Three systems of 65,000 cfm each have long single ducts with outlets that blow out about 80 ft on each side. In summer the outlets are turned slightly downward for comfort circulation in the populated areas.

In this 400 × 500 ft structure nobody complains about summer heat, despite the fact that the building is almost windowless.

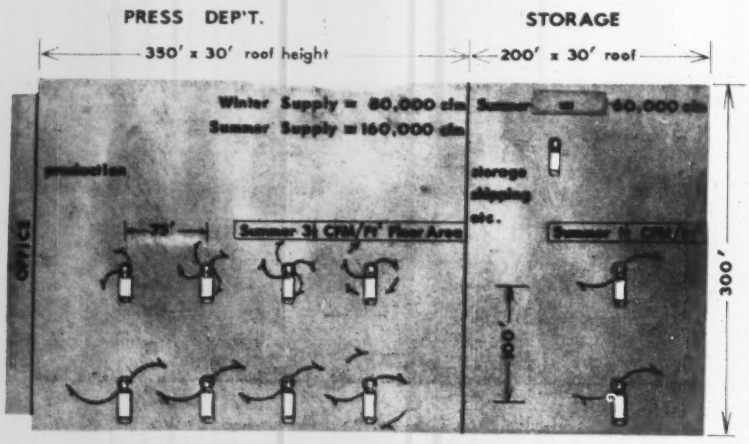
There is growing acceptance for windowless buildings having makeup air systems that double in summer to provide air motion and summer ventilation. Also, such systems are nearly always adaptable to the future addition of mechanical cooling and lengthening the duct runs to cover additional floor area.

Variety of Equipment Available

Recent years have seen the advent of new types of equipment for supplying plant makeup air. A brief rundown would be worthwhile. Common to each type is a source of heat for warming the air, an outside air connection, a fan, and some form of directional air control. This equipment includes:

1) Blower type unit heaters in 10,000 to 25,000 cfm sizes. These are very popular. The addition of short ducts and floor adjustable grilles for different summer and winter adjustments is becoming standard practice.

2) Central fan systems. By means of ducts, grilles, and temperature controls, air can be supplied draftlessly in winter. Yet it can be spotted accurately in summer for optimum outdoor air circulation in hot working areas. For heavy-duty summer benefits, conversion to evaporative cooling is available.



FLOOR PLAN of properly ventilated plant shows locations, capacities of units supplying makeup air and having slowly rotating, two-nozzle air delivery head at each unit heater

3) Roof supply ventilators. Below the roof, a heating coil is mounted, with control preferably by face and bypass dampers. These can be located at will over interior areas where summer outdoor air supply is needed.

4) Self-contained unit heaters. These are available either gas or oil fired and have large capacities up to 25,000 cfm. With reasonable gas rates, annual fuel costs can be kept low and the resultant savings can offset the cost of the unit.

5) Direct fired air heaters. These specialized units for limited application consist of suitable gas burners that operate directly in the air stream, being located either near the high velocity area of the fan inlet or else near the low velocity air intake rain louvers. Applications are currently restricted to makeup units that cannot possibly recirculate room air.

6) Heat recovery units. A revolving wheel of slight depth is arranged to give up the heat contained in the heat storing medium to warm the colder incoming air. This heat has been removed and accumulated from the warm exhaust system air. Thus, the heat recovery unit is attached to an exhaust system that must be reasonably free of foreign matter. One such installation that has an air flow rate of 16,000 cfm will heat zero F air to 80 F when exhaust air enters at 100 F and discharges to the stack at 20 F.

In all six categories there are common essentials. A prominent engineer writes, "It has been my experience that air supply units without proper control and or distribution are not acceptable to the employees in a plant and that it is impossible to keep them in operation because of the uncomfortable conditions that such units generate."

Cold Weather Problems Common

The subject of makeup air always brings to mind the problems inherent in dyeing and finishing plants and bleacheries. These industries have always been troubled with drafts and cold areas in severe winter weather. Too much exhaust and excessive cold air infiltration seems to be the rule, at least in the older plants. But today's newer finishing plants, equipped with proper makeup air systems, have very few cold air problems.

Steam from the vats and elliptical reels on the fourth floor finishing department in an underwear manufacturing plant fogged-up the area so badly in cold weather that visibility was almost impossible. This fog extended in a solid mass down to the 3 or 4 ft level. There was no makeup air. Exhaust fans in the windows were handling air that short circuited from adjacent openings in the same sash.

After a central makeup system was installed to provide heated outdoor air, the fog evaporated, leaving no trace. The blotter effect of low relative humidity makeup air did the trick.

In another plant[2], unit heaters, each rated 20,000 cfm, supply the necessary winter makeup air. These units operate in winter in conjunction with foil rolling mill oil mist exhaust and others. The entire plant building is heated with medium temperature hot water (250 F). The outside air heating coils use hot water successfully.

In this windowless building, filtered and forced makeup air supply is necessary to afford the cleanliness and sanitation required for the manufacture of aluminum foil plates for pies and TV dinners. The structure is cooled in summer by a unique outdoor air distribution method: a revolving nozzle on each unit heater delivers two air streams of about 10,000 cfm each.

Adequate floor coverage and internal heat loads necessitate four more air units in summer. These are identical to the other unit heaters, except they don't have heating coils. The air filtering method requires very few trips up into the trusses, since throwaway roll type filters are installed.

How to Combat Coil Freeze-ups

Since the use of steam predominates in makeup air systems and since freeze-ups of air heating coils have been known to occur in the best of installations, much interest is directed to this difficulty. Based upon actual case histories of successful installations experiencing very few if any coil freeze-ups, three basic rules have been followed, almost without exception:

1) Steam must be delivered at high pressure from the boiler house or plant loop, to pressure reducing station in the fan room where it is lowered to about 15 psi. The air heating coils are thus free and unhampered by unit heater feeders that may be manipulated, controlled, or shut off by unauthorized people.

2) Coils should be set so that the tubes are vertical and thus free draining. Supply connection may be on the bottom. The coil banks are mounted on stands to elevate the condensate header 3 to 4 ft above the floor for gravity drainage to a nearby duplex condensate pump.

3) A separate duplex condensate pump is expressly installed in the fan room to serve this system or several systems. The pumps may also serve some unit heaters, but only as a subordinate measure.

The features of independent condensate pumps can apply equally as well to batteries of outside air unit heaters. This idea of a separate entity aids in keeping traps and control instruments more adequately serviced.

Let's remember that industrial makeup air and air supply have the primary duties of furnishing air to replace that removed by exhaust systems, overcoming the discomfort of cold buildings, and preventing the occurrence of cold drafts.

Nearly as important as these are the summer benefits of outdoor air, air circulation, and cooler buildings. This feature adds only a fraction to the cost of the winter installation. ∓

[1] *Place New Importance on Design of Industrial Air Supply Systems*, by John H. Clarke, Heating, Piping & Air Conditioning, April 1958.
[2] *Summer-Winter Comfort Ventilation in Industry*, by B. R. Small, Heating, Piping & Air Conditioning, February 1957.

An Effective Way to Heat Hospitals: Radiant Heat + "Complete" Insulation

Hospital heating costs can be greatly reduced if full insulation and double glazing are used, according to the author. In this article he supports this premise with several case histories where hot water radiant heating has been used with success.

BY CHARLES F. NEERGAARD
Hospital Consultant Retired

LACKING truly heat-tight walls and windows, we are heating "all outdoors" at a staggering waste of fuel. Why not design for greater comfort and save money at the same time? It has been demonstrated that it can be done!

It was in 1931 that James Govan, an ingenious Canadian architect, opened my eyes to the possibilities of insulation. We were collaborating on a hospital job on Prince Edward Island where winters are cold and funds were scarce. Mr. Govan designed a heavily insulated wall and triple-sash windows. A leading engineer planned the heating plant in which, he said, he had reduced the radiation to 57 percent of normal. (Subsequent operating water temperatures indicated that the radiation could have been reduced to 40 percent of the engineer's calculated requirements with the same water temperature.)

Operating data for the first winter showed that, to maintain a 70 to 75 F temperature in the rooms, the water circulated through the radiators averaged only 108 F; the engineer had predicted 150 F. Water temperature rose to 135 F only three times during the subzero weather. Today, the original 60 hp boilers are still in service, although the hospital has been considerably enlarged.

Some years later a hospital project in Hagerstown, Md., presented an ideal opportunity for a practical demonstration as to what the cost would be for installing complete insulation. A million dollar fund was available for the erection of the Bloom Memorial Wing — an addition to a beautiful old school then being used as a hospital. The building committee and the architects approved of the idea of doing something different and appointed as consulting engineer my old associate, Charles E. Daniel.

This was the first multistory steel frame building in the entire country to have completely insulated walls and double-glazed windows. The cavity wall consisted of 12 in. of brick with a 3 in. backing on which plaster was applied directly. The heat loss factor was 0.095. This was the first time that double glazing was used throughout a large building.

Mr. Daniel made a careful appraisal of the heat values of the walls and double-glazed windows and found that he could safely reduce the radiation to an average of 1 EDR for every 160 cu ft of space to be heated. This was about half of what he had been using in uninsulated hospital buildings.

He designed a closed system using hot water, properly zoned with inside and outside thermostats. The system was extremely flexible and economical, the water through the radiators

ST. JUSTINE Hospital for Children, Montreal, is just one of many hospitals where heating costs have been slashed through "complete" insulation and radiant heating

varying from 90 to 200 F, depending on the outside temperature. It proved most economical to operate, cutting the fuel consumption at least in half.

After the building was completed and occupied, we visited it to check on the comfort.

The president of the hospital board remarked, "When you fellows were putting in those little radiators, we thought you were crazy. But they work!"

Also, he found the building was comfortably cool, even on the hottest days during the summer.

To determine what was being gained by the insulation, we placed recording thermometers in the new wing and in an adjoining uninsulated wing. For several weeks the temperature in the new wing averaged 8 F lower.

Why Not Air Conditioning, Too?

The question naturally arises: Why is it that insulation and double glazing are not used to reduce the first cost and operating cost of air conditioning plants? If it can cut the heating plant in half, it should be well worthwhile with air conditioning.

A year or so later we built a large double corridor wing at St. Luke's Hospital, Bethlehem, Pa. We used the same wall insulation and double glazing. The double corridor plan, because of its efficient design, required only 1 sq ft of radiation to 200 cu ft to be heated, 25 percent less than the single corridor design at Hagerstown.

The hospital wing at Hagerstown and St. Luke's at Bethlehem were the pioneer examples of how departure from routine practice can greatly improve a building without increasing its original cost. The Hagerstown builder reported the amount saved in the heating plant met the extra cost of the better walls and windows. Several subsequent hospital jobs, similarly designed, have confirmed the Hagerstown findings.

"I Was Comfortable at 60 F"

The principle of radiant heating had long interested me, but it was not until on a trip to London in 1929 that I discovered the advantages of "panel warming," as they call it in England. I spent six cold winter weeks in a panel warmed office where the air temperature averaged 60 F and was very comfortable working there in my shirtsleeves.

The London Central Bureau of Hospital Information gave me its report on panel warming, based on the experience of 42 hospitals covering 16 to 20 years with an aggregate of 232 heating seasons. There were no leaks and no repairs required for any imbedded panels. Cracks and discolorations of ceilings were negligible. Less cleaning and less frequent decoration were required. Control valves in each room were rarely used as the boiler room control of the circulated water temperature was sufficient. Even distribution and comfortable temperatures were easily maintained.

When I returned to the U.S., I learned that the English system with panel coils in the ceiling was being used in the British Embassy in Washington and also in a number of apartment buildings. However, engineers warned that it was too extravagant to be practical for hospitals. I went through some radiant heated apartment buildings while they were under construction and was convinced that the system might be much simplified and improved if combined with insulation and double glazing.

Pioneering Idea Pays Off

It was not until 1949 that a favorable project emerged for this pioneering idea — a new hospital in Warwick, R.I. The architects concurred on using complete insulation and double glazing. At my suggestion they retained as consulting engineer, Ernest Franck, who knew what to do.

Mr. Franck strongly favored panel heating and approved the idea of combining it with insulation and double glazing. He prepared a complete set of heating plans for radiant heat with prefabricated steel coils in the bottom of a thin concrete floor slab. The structural engineer designed a precast concrete wall and suggested many shortcuts for the installation of the coils. The heating contractor, who had installed several

radiant heating jobs, saw great possibilities in the use of insulation. The insulation made it possible to increase the distance between ceiling coils and to omit the sidewall coils — usually placed under the windows. The job has proved most satisfactory and now, after 10 years, they are adding a new wing, installing radiant heating.

In 1948 we were retained as consultants for an addition to the Glen Cove, N.Y., hospital. For the new wing, built in 1950, we used an insulated cavity wall and double glazing with flat reinforced concrete slab construction. Ernest Franck, as engineer, suggested and designed the radiant heating system. Since 1950 the Glen Cove plant has been expanded with the addition of a school for practical nurses and a dormitory, a 75-bed patients' wing, an out-patient wing, and an emergency and admissions department — all with insulation and radiant heat.

The original hospital had contained 1,015,000 cu ft. The five additions aggregated 2,046,000 cu ft. This entire load is now being carried by one of the original 300 hp boilers, the other serving as a standby. The only change was to put in automatic oil firing with metered combustion control.

Mr. Frank has had wide experience with radiant heating, and he states that, while the initial cost is somewhat higher, after the concrete work is finished the heating system is completed. After the coils in the ceilings are in place the maintenance is minimized for several years.

A Swiss Testimonial

We had another interesting project — the fabulous 800-bed St. Justine Hospital for Children in Montreal. When we were retained the plans were practically finished and the construction underway. They accepted our recommendations for insulation and double glazing. When we suggested radiant heating, one of the doctors said that he had recently visited the Civic Hospital of Basle, Switzerland, which had a new wing with this type of heating. He wrote for information and the director reported that, to maintain a room temperature of 72 to 75 F in their new panel heated pavilion, the maximum inlet temperature was only 93 F. In summer, cold water was circulated through the ceiling system maintaining 79 F inside when the outside temperature was 95 F. However, in Basle there is no humidity problem. Some years after St. Justine was completed I asked the president, Madame L. De G. Beaubien, for a report on the plant. She said:

"The radiant heating and insulation in the hospital have given entire satisfaction. Our only regret is that it was not also installed in the nurses school and personnel residences. However, it helps us now to establish a comparison in favor of panel heating, and it reminds us constantly of the gratitude we owe you and your associates for having suggested the idea."

Research New Insulation

The New York State Housing Authority has initiated significant research in the cost of housing. Joshua D. Lowenfish, chief of the Authority's architectural research bureau, is now directing a study at the Pratt Institute School of Architecture on wall insulation. John Callender, of the Pratt faculty, has designed a 10½ in. insulated curtain wall using rigid insulation that has a U factor of 0.075.

Unit costs of a typical story of a large housing development now under construction were secured, together with other data. The total cost of the Pratt wall with its U value of 0.075 was $2.61 per sq ft compared with the present wall with a U factor of 0.241 costing $2.63 per sq ft.

It has been estimated that if, in addition to the Pratt wall, they had used double glazing and a properly designed heating system, this group of buildings could have been built at little, if any, increase in first cost. The ultimate investor would have benefited by a major reduction in fuel consumption and the tenants would experience greater year 'round comfort.

The idea of the demonstration to determine actual costs in the field has been endorsed by many but undertaken by no one. I suggest such a demonstration of a group of four or more identical units, two of which would be the *prototypes* completely insulated, one with hot water panel heating and others with other types of systems. From this would emerge proof of the cost factor and operating results.

Crusade Is Bearing Fruit

The long crusade to promote a more general use of adequate insulation is beginning to bear fruit. A number of architects with whom we have collaborated on hospitals in the past are now advocating the application of wall insulation and double glazing.

Helge Westermann, my former partner and the designer of several of the buildings in Glen Cove, is architect for a new hospital in Vineland, N.J. He is using insulation and panel heating. Mr. Westermann is associated with Pietro Belluschi, architect for the Juilliard School of Music and dormitory to be built in the Lincoln Center. They will also design a high school for the city adjoining the Center. He has recommended to the planning board that it consider using insulation, double glazing, and radiant heating in appropriate buildings.

The most significant late news is at Yale University, where Eero Saarinen is designing two new college buildings, largely dormitories, which will aggregate some 3 million cu ft. David Hummel, head of the university's division of engineering and new construction, and Mr. Saarinen have decided to use complete insulation, double glazing, and panel heating in these structures. They are keenly interested in the possibilities of a demonstration of a low cost heating system in college buildings.

Adoption of this advanced type of building and heating design for these Yale buildings should be of great interest to those responsible for the many new educational buildings to be erected. ±

the law and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

Oral Agreement with Building Owner Leads Contractor into Court Battle

GENERALLY, it's the law that a written contract cannot be varied in its terms by oral or verbal agreements. The advisability of reducing all contractual provisions to writing is shown in this case.

Scott Draft, a heating contractor, filed a lawsuit against the Temperate Health Club, a nonprofit organization, for the reasonable worth of labor and materials furnished in connection with the installation of a heating plant in the club's gymnasium. The club defended on the ground that Draft had breached the contract for the failure of a guaranty.

The contractor denied the existence of a written contract and argued that he had merely submitted a written bid. The alleged bid, along with stating specifications for the heating system, contained the following provisions:

"The system is guaranteed to maintain the building at 72 F when it is zero F outside.

"The plant is to be installed complete for the net sum of $5200."

Draft contended and testified: (1) that, prior to making the bid, he was called to estimate on the plant; (2) that the ceiling of the gymnasium was in such bad repair that he could see through the roof; (3) that several windows were broken; and (4) that the officers of the club had represented that everything would be repaired within the immediate future.

Draft further stated that after he had installed the plant, the officer of the club told him that they could not afford to make the repairs.

"How," asked Draft, "could I be expected to fulfill a guaranty of maintaining a temperature of 72 F inside at zero F outside when the gym was in such poor condition?"

"But the *written contract* said he would," argued the club. "There is nothing in the contract obligating us to make such repairs. Under the law he is bound by the terms of the contract and he cannot vary the terms of the written instrument by evidence of any alleged oral agreement. The heating plant is inadequate and, therefore, he has breached the guaranty under the contract."

The jury returned a verdict in favor of the contractor in the sum of $4800. The club appealed to a higher court.

The higher court agreed with the club that there was a contract and it contained a guaranty. But, the court held, the written bid was only a part of the contract. The bid was, in effect, an offer subject to the acceptance or rejection by the club.

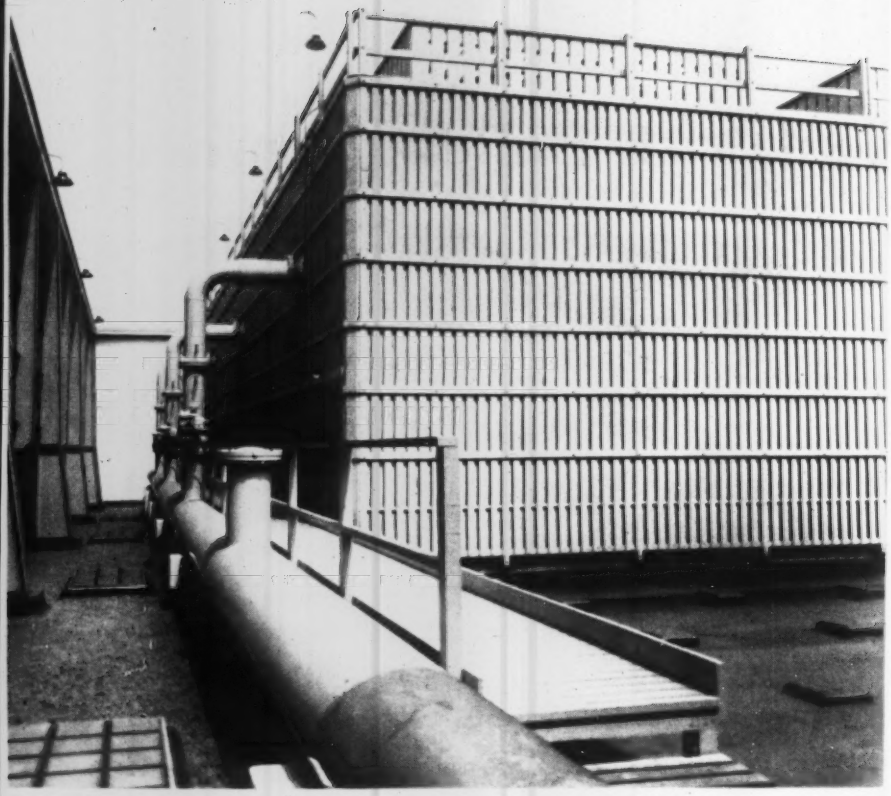
The acceptance was oral, continued the court. Where there is an oral acceptance of a written offer to do certain work, the fact that the offer was in writing does not bring the contract within the rule excluding oral or verbal evidence which tends to vary the terms of a written contract.

The court further stated that it was repugnant to common sense that any heating contractor would propose to make such a guaranty to heat a building with many windows broken and holes in the roof. Contractors do not make such guaranties to heat the outdoors in zero weather, as was almost the case here.

The promise of the club to repair the building was an inducement for the bid and a condition precedent to complete performance under the contract by the contractor. When the repairs were not made, the contractor had a right to regard the contract as broken by the club and to proceed to sue for the reasonable worth of work and materials furnished.

Although Draft was successful in his lawsuit, he learned a lesson from the court which stated that it was unfortunate that all the terms and conditions of the agreement were not set out in a written contract. If such had been the case, said the court, there likely would have been no litigation before the court. ✣

New Formula Predicts Performance



TO PREDICT ability of this tower to perform as specified, only a single determination of performance — either from one operating point or test rating — is necessary for use with this new formula. Equation is applicable for tower leaving water temperatures 70 F and above, tower entering water temperatures below 110 F

● How can you check to be sure a counterflow cooling tower will perform as specified? How will it perform under operating conditions other than those specified? The answers to both these questions can be found quickly and easily through the use of the newly derived equation described here. This flexible method, the first of its type to be published, requires but a few simple calculations to determine accurate performance predictions.

William T. Lyons, senior application engineer for the Machinery and Systems Div. of Carrier Corp., is a mechanical engineering graduate of Notre Dame University. During nearly 23 years with Carrier he has divided his time between field and home office engineering.

Of Counterflow Cooling Towers

. . . for air conditioning duty

BY WILLIAM T. LYONS
Senior Application Engineer
Carrier Corp.

COOLING TOWERS are like people in that their performance can be measured. But, unlike people, their performance can also be accurately *predicted*. Once a tower has been put into operation, its performance pattern is fixed so that only a physical alteration of the tower or a change in water or air quantities through the tower will change it.

Only a single determination of performance and use of the proper formula is required. You can then ascertain how that tower will perform under other conditions. Thus, from one operating point or test rating, you can predict whether a cooling tower will perform as specified, as well as predict its performance under a load greater than that for which it was originally selected.

Unlike industrial process applications, the cooling tower load on an air conditioning system will normally vary with the outside weather conditions. The range (entering and leaving water temperature difference) required by the refrigeration cycle may therefore vary and be different at design than at a condition under which observations are made.

Performance of a counterflow cooling tower can be calculated arithmetically in a simple, rational, and accurate manner. This article describes such a method. The article is not intended to promote the field testing of towers, but rather to show how their performance may be predicted once a set of observations at one operating condition is available.

You need not wait for design conditions to occur to determine whether a cooling tower will perform as specified. Nor must you remain in doubt as to whether increasing the load (range) on an existing tower is economically feasible. Only one operating point or one test rating is required. With such information the performance of the tower can be predicted throughout most of its operating range.

Qualify Proper Use of Equation

The method makes use of an equation with the test conditions properly related on the one side and equal to the predicted conditions, similarly arranged, on the other side. Thus, an unknown condition on the latter side may be calculated.

Proper use of the equation should be qualified:

1) The equation is applicable for tower leaving water temperatures at or above 70 F and tower entering water temperatures at or below 110 F.

2) The water and air quantities must remain constant for both the predicted performance and the test results.

Such qualifications should present no undue hardship, since the temperatures mentioned cover most air conditioning applications. In addition, there is little reason for the air and water quantities to be other than constant, per design, once the tower is properly installed and the water piping system properly designed. Bypass valves do vary water quantities, but even these may be maintained in a closed position temporarily while observing the operation of the tower.

Obviously, the accuracy of a prediction depends on the accuracy of the observation or test rating. Observations that can normally be made in the field, such as air and water temperature readings, should produce reasonably accurate predictions of performance. Predictions based upon more precise measurements of air and water flow and temperatures, such as are possible in a laboratory, will of course be still more accurate.

Here is the equation:

$$\{[M/M'(Tw_1 - Tw_2)]/[H - Tw_1 R - Tw_2 S + 0.0013\, Tw_1 Tw_2]\} = \{[Tw_1' - Tw_2']/[H' - Tw_1' R - Tw_2' S + 0.0013\, Tw_1' Tw_2']\}$$

where:

Tw_1 = water temperature, F, entering tower at observed conditions

Tw_1' = water temperature, F, entering tower at predicted conditions

Tw_2 = water temperature, F, leaving tower at observed conditions

Tw_2' = water temperature, F, leaving tower at predicted conditions

M = multiplier (from Table 1) for observed conditions (interpolation is permissible)

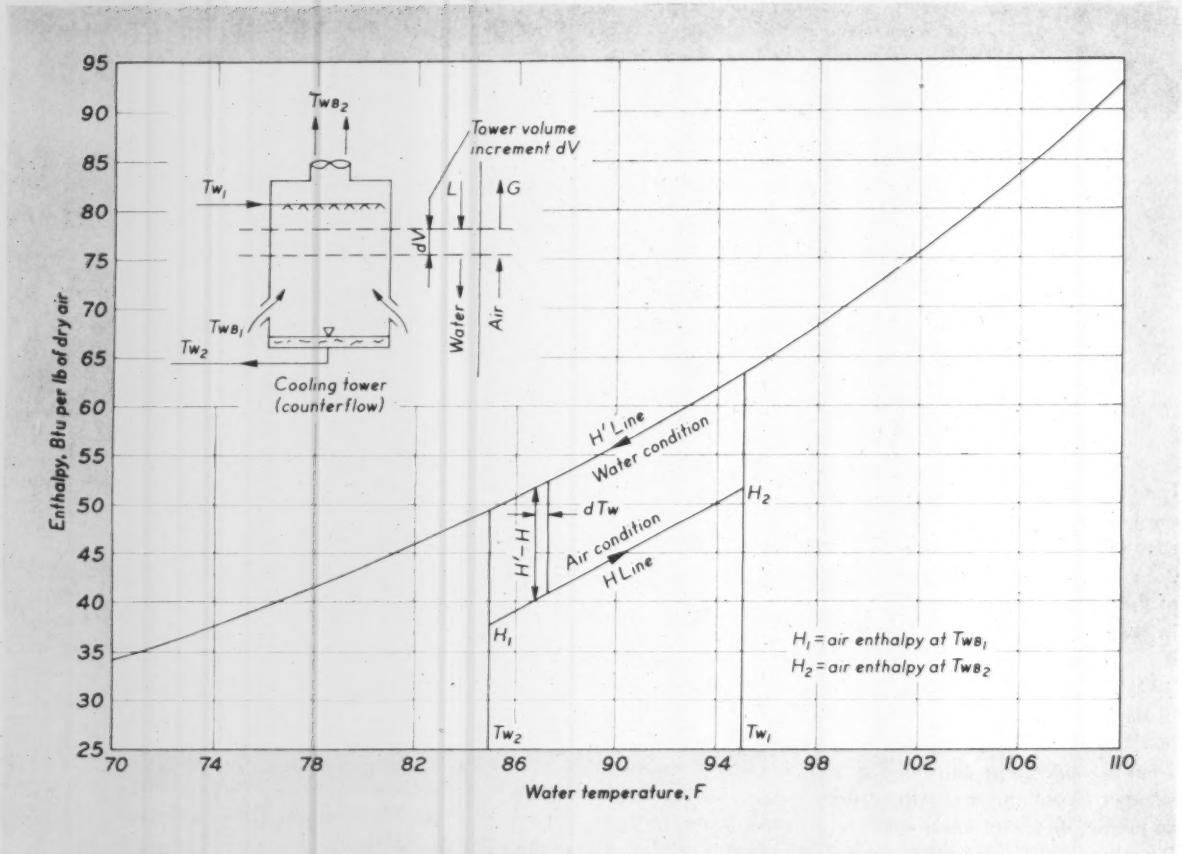
M' = multiplier (from Table 1) for predicted conditions (interpolation is permissible)

H = value (from Table 2) dependent upon wet bulb temperature of air entering tower at observed conditions

H' = value (from Table 2) dependent upon wet bulb temperature of air entering tower at predicted conditions

R = value (from Table 3) dependent upon gpm/cfm ratio (constant for both sides of equation)

S = value (from Table 3) dependent upon gpm/cfm ratio (constant for both sides of equation).



1 H' LINE REPRESENTS water condition as it passes through tower as well as enthalpy of air at surface of water film. This is saturation line, same as is found on psychrometric chart. Between 70 and 110 F WB, it can be approximated very closely in terms of temperature. H line, representing air condition as it passes through tower, in opposite direction to water, may be expressed in terms of entering air enthalpy to tower, water-to-air ratio, and water temperatures. L and G in tower schematic are water flow and air flow, respectively, in lb per hr

Each side of the equation is the result of but a single mathematical integration of the expression:

$$\int_{Tw_2}^{Tw_1} \frac{d\,Tw}{H'-H}$$

where:

- $d\,Tw$ = increment of drop in cooling tower water temperature as it passes through cooling tower
- H' = enthalpy of air at saturation, corresponding to that water temperature
- H = enthalpy of air body passing through tower at that particular point in its passage.

The above expression is well recognized to be equal to $\int K\,a\,dV\,/L$. (a = heat exchange area, sq ft/tower volume, cu ft; K = diffusion constant.) It can be proven to be a constant for all operating points of a tower, provided the air and water quantities through the tower are maintained constant. Since we are dealing with a constant, both sides of the equation are equal.

Referring to Fig. 1, the H' line, representing the water condition as it passes through the tower as well as the enthalpy of the air at the surface of the water film, is the saturation line. This line is the same as is found on a psychrometric chart. Between wet bulb temperatures of 70 and 110 F, it can be approximated very closely by an equation in terms of temperature.

The H line, representing the air condition as it passes through the tower in the opposite direction to the water (counterflow), may be expressed in terms of entering air enthalpy to the tower, water-to-air ratio, and water temperatures.

Altitude above sea level will have no practical effect on the accuracy of the equation; counterbalancing forces only play a role at altitudes other than sea level.

Here are two practical examples using the equation. Others may suggest themselves to you, depending on the problem with which you may be confronted.

Example 1: Does Tower Meet Design Spec?

A counterflow cooling tower is specified to cool 600 gpm of water from 93 to 83 F at 75 F WB. The manufacturer's data indicates that 47,500 cfm of air through the tower is required. The engineer wants to determine now whether the tower will perform as specified. Field observations indicate that the wet bulb temperature of

TABLE 1—VALUES of M, multiplier used in equation, for various wet bulb temperatures of air entering tower and gpm/cfm ratios listed below

Ratio, gpm/cfm	Entering wet bulb temperature, F						
	60	65	70	72	75	78	80
0.0065	0.926	0.947	0.971	0.975	1.000	1.022	1.026
0.0084	0.970	0.977	0.984	1.000	1.000	1.010	1.023
0.0106	0.978	0.984	0.984	1.000	1.000	1.000	1.000
0.0127	1.000	1.000	1.000	1.000	1.000	1.000	1.000

TABLE 2—H VALUES for various wet bulb temperatures of air entering tower are as follows

Temperature, F WB	H*	Temperature, F WB	H*	Temperature, F WB	H*
60	3.3782	67	3.0046	74	2.5673
61	3.3282	68	2.9467	75	2.4985
62	3.2776	69	2.8866	76	2.4290
63	3.2254	70	2.8258	77	2.3566
64	3.1719	71	2.7635	78	2.2855
65	3.1176	72	2.6998	79	2.2082
66	3.0618	73	2.6339	80	2.1307

*$H = 5.294 - 0.0724\ t_{WB}$

TABLE 3—R AND S VALUES for various gpm/cfm ratios tabulated here

Ratio, gpm/cfm	R*	S‡	Ratio, gpm/cfm	R*	S‡
0.0063	0.0915	0.0402	0.0127	0.1171	0.0145
0.0068	0.0932	0.0384	0.0128	0.1176	0.0140
0.0070	0.0943	0.0374	0.0133	0.1197	0.0119
0.0075	0.0963	0.0353	0.0138	0.1217	0.0099
0.0080	0.0985	0.0333	0.0143	0.1237	0.0079
0.0084	0.1000	0.0316	0.0148	0.1258	0.0058
0.0088	0.1014	0.0302	0.0153	0.1278	0.0038
0.0093	0.1034	0.0282	0.0158	0.1298	0.0018
0.0098	0.1054	0.0262	0.0163	0.1319	−0.0003
0.0103	0.1075	0.0241	0.0168	0.1339	−0.0023
0.0106	0.1086	0.0231	0.0173	0.1359	−0.0043
0.0110	0.1106	0.0211	0.0178	0.1380	−0.0064
0.0115	0.1126	0.0191	0.0180	0.1390	−0.0074
0.0120	0.1146	0.0170			

*$R = 0.0658 + (4.065 \text{ gpm/cfm})$
‡$S = 0.0658 - (4.065 \text{ gpm/cfm})$

the air entering the tower is only 65 F. Further observations reveal that the entering water temperature is 90 F and the leaving water temperature is 81.1 F. It can be assumed that the water quantity has been set at design by throttling a pump discharge valve until the pressure drop at the condenser is in accordance with design. Unless there is some restriction to flow of air to the tower, it may be assumed that the air quantity is as indicated.

Does the cooling tower meet its design specification? Presume that the temperature of water entering tower at design will be 93 F and solve for the leaving water temperature:

Given:

$Tw_1 = 90.0$ F
$Tw_2 = 81.1$ F
$Tw_2^1 = 93.0$ F
$M = 1.0$ (from Table 1) for 65 F WB and gpm/cfm ratio of 600/47,500, or 0.0127
$M^1 = 1.0$ (from Table 1) for 75 F WB and gpm/cfm ratio of 600/47,500, or 0.0127
$H = 3.1176$ (from Table 2) for 65 F WB
$H^1 = 2.4984$ (from Table 2) for 75 F WB
$R = 0.1171$ (from Table 3) for gpm/cfm ratio of 0.0127
$S = 0.0145$ (from Table 3) for gpm/cfm ratio of 0.0127

Required:

Tw_2^1

Procedure:

Plug in given values in the equation and solve for required value:

$$[11.1\ (90 - 81.1)]/[3.1176 - 90\ (0.1171) - 81.1\ (0.0145) + 0.0013\ (90)\ 81.1]] = [[193 - Tw_2^1]/[2.4984 - 93\ (0.1171) - Tw_2^1\ (0.0145) + 0.0013\ (93)\ Tw_2^1]] \quad \ldots\ldots[1]$$

$$9.98 = (93 - Tw_2^1)/(0.1064\ Tw_2^1 - 8.3919) \quad \ldots\ldots[2]$$

$$1.0619\ Tw_2^1 - 83.4212 = 93 - Tw_2^1 \quad \ldots\ldots[3]$$

$$Tw_2^1 = 85.6 \text{ F} \quad \ldots\ldots[4]$$

Therefore, the tower will cool 600 gpm of water from 93 to 85.6 F at 75 F WB. However, since it was specified to cool 600 gpm of water from 93 to 83 F at 75 F WB, the tower fails to meet the design specifications.

Example 2: What Is Effect of Range Change?

Again, the tower in Example 1 was calculated to cool 600 gpm of water from 93 to 85.6 F at 75 F WB. With a load on the tower equivalent to a 10 F range, to what leaving water temperature will the tower cool 600 gpm water at 75 F WB?

Solve directly for Tw_2^1. So that you don't have to resort to trial and error, the equation has been rearranged and condensed as follows:

$$Tw_2^1 = -[0.0013 \text{ range} - 0.1316 \pm \sqrt{(0.0013 \text{ range} - 0.1316)^2 - 0.0052\ [H^1 - \text{range}\ (R + (M^1/Mk))]}]/0.0026$$

Given:

$Tw_1 - Tw_2^1 = \text{range} = 10$ F
$M = 1.0$ (from Table 1) for 65 F WB and gpm/cfm ratio of 600/47,500, or 0.0127
$M^1 = 1.0$ (from Table 1) for 75 F WB and gpm/cfm ratio of 600/47,500, or 0.0127
$H^1 = 2.4984$ (from Table 2) for 75 F WB
$R = 0.1171$ (from Table 3) for gpm/cfm ratio of 0.0127
$k = 9.98$ (from Example 1)
$= (Tw_1 - Tw_2)\ (H - Tw_1 R - Tw_2 S + 0.0013\ Tw_1\ Tw_2)$

Required:

Tw_2^1

Procedure:

Plug in given values in the condensed equation:

$$Tw_2^1 = [0.0013\ (10) - 0.1316) \pm \sqrt{(0.0013\ (10) - 0.01316)^2 - 0.0052\ [2.4984 - 10\ (0.1171 + (1/9.98))]}]/0.0026$$

$$Tw_2^1 = 0.1186 \pm \sqrt{[(0.1186)^2 - 0.0052\ (0.3254)]}/0.0026 \quad \ldots\ldots[2]$$

$$Tw_2^1 = 0.1186 \pm (0.1112/0.0026) = 0.2298/0.0026 = 88.4 \text{ F} \quad \ldots\ldots[3]$$

(The second value of Tw_2^1 determined in Equation 3 is obviously inadmissible and must therefore be rejected.)

Therefore, the tower will cool 600 gpm of water from 98.4 to 88.4 F at 75 F wet-bulb.

By knowing Tw_2^1 and Tw_1^1 in Example 2, you can proceed to evaluate the penalty inflicted on the refrigeration cycle and air conditioning system at design conditions.

If you are predicting a performance under a load greater than that for which the tower was originally selected, it is obvious that a value for k must first be determined from either an operating point or a test rating.

Space prohibits additional examples or a description of the results obtained with the use of the equation. Suffice it to say, it works. Try it. ∓

Pressure Losses in Refrigerant Piping: What You Can Do About Them

● Excessive pressure loss due to friction in refrigerant piping has a marked adverse effect on system performance. To make sure you are getting the optimum refrigeration capacity from a system it is necessary to: first, calculate the pressure loss; second, predict what effect it will have on performance; third, take the necessary measures to control its magnitude. This article tells how to take these three steps to peak operating efficiency.

BY W. C. SMITH
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W. C. Smith received his BS in mechanical engineering from Virginia Polytechnic Institute in 1949. After graduation he joined Worthington, serving in its air conditioning and refrigeration research laboratory. He was awarded his masters degree in engineering at Stevens Institute in 1957. For the past seven years he has been a product engineer, working on special petrochemical and low temperature refrigeration systems.

WHEN A FLUID flows through a pipe, there must exist some pressure loss in the direction of flow. In the case of refrigerant piping systems, three things must be known about pressure losses due to friction:

1) How to calculate the pressure loss
2) What effect this loss will have on performance
3) How to control its magnitude.

The simplest way to determine the friction loss will be by using Air-Conditioning and Refrigeration Institute's soon to be published *Refrigerant Piping Data*. The ARI material will satisfy virtually all common needs for data on pressure losses for refrigerants 12, 22, and 717 (ammonia). Two methods of obtaining values of pressure loss will be provided in that publication.

One is the use of nomographs which eliminate the need for calculating the results by means of the friction equation, requiring as entries only a mass flow rate, tentative pipe or tubing size, and the condition (state and temperature) of the refrigerant in the pipe. Pressure loss due to friction per 100 ft of pipe is the product of this nomogram.

The other presentation will be a tabulation of refrigeration capacities (tons) considered to be the limit for each pipe size. Such tables are listed for suction, liquid, and discharge lines. This data can only represent what is considered good practice for *normal* ranges of cycle conditions. It does not provide one with the actual values of pressure drop to expect and, therefore, will not enable a precise evaluation of the effect of the line loss on the system performance. In many cases such analyses are quite necessary.

The basic theory behind the ARI work and the most widely accepted method for calculating friction loss for all general piping is the use of the Fanning equation in conjunction with Moody's charts, as recommended by the Hydraulic Institute.

This takes the familiar form

$$h = f\,(l/d)\,(V^2/2g)$$

or:

$$\Delta P = (\rho/144)\,f(l/d)\,V^2/2g)$$

where:

h = friction head loss of liquid flowing, ft
f = Fanning friction factor from Moody charts
l = length of pipe, ft
d = inside diameter of pipe, ft
V = velocity of flow, fps
g = acceleration due to gravity, 32.2 fps^2
ρ = density of fluid, lb mass per cu ft
ΔP = pressure loss, psi.

To obtain f from the Moody chart, the Reynolds number must be calculated

$$\mathrm{Re} = (\rho\,dV/\mu)$$

where:

μ = viscosity of fluid flowing as expressed in the units lb per ft-sec. ($6.72 \times 10^{-4} \times$ value of viscosity in centipoise, as it is usually expressed.)

All of this is really not as complicated as it might appear. However, the calculation does presuppose a pipe size (which is also the thing usually being sought). If the first guess is not satisfactory, the process must then be repeated. The following velocity ranges are suggested for indicated service to help "zero in" to a suitable selection quickly.

Suction gas lines, 2000-5000 fpm
Discharge gas lines, 3000-4000 fpm
Liquid lines, 180-250 fpm
Free drains (such as condensers to receivers) less than 100 fpm

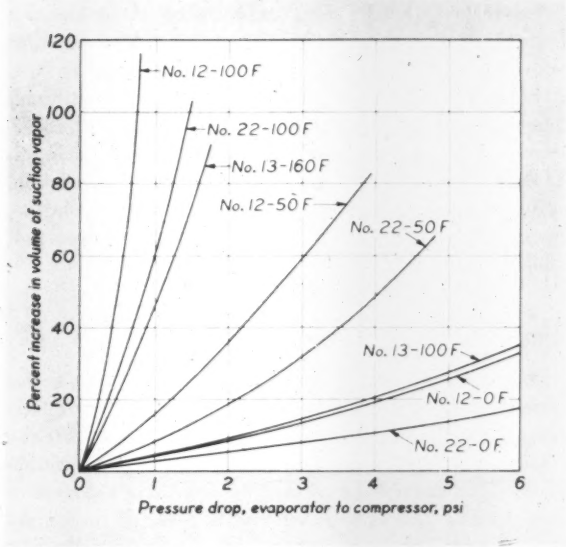
Friction losses for valves and fittings are best determined from flow coefficients (k) which replace the $f\,(l/d)$ part of the Fanning equation for pipe. Thus:

$$h \text{ fitting} = k\,(V^2/2g)$$

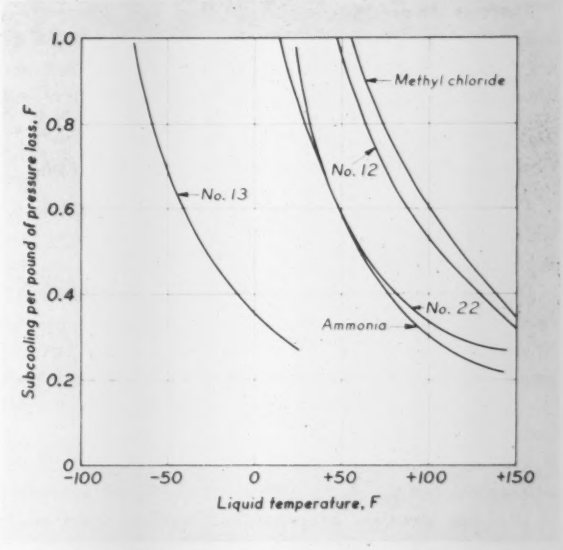
and

$$P \text{ fitting} = (\rho/144)k\,(V^2/2g)$$

However, the k values for all fittings, especially valves, are not always available. As more and more users request this information from vendors, it must certainly be made available. It's probably safe to assume that the firms



1 HOW PRESSURE LOSS in suction line increases capacity requirement of compressor for various refrigerants at several operating temperatures below zero F



2 SUBCOOLING REQUIRED to prevent flashing in liquid lines for each pound *net* pressure for several refrigerants *vs* liquid temperature plotted here

whose products have low k values will be among the earliest to publicize them. The point here is that the friction losses will vary, not only among different types of valves and fittings, but also among different designs and sizes of the same type of valve or fitting. Some average values of k are presented in the ARI publication mentioned.

Friction loss due to an equivalent length of straight pipe is popularly substituted for pressure losses due to fittings, although it is not rigorously correct as a concept and is still subject to the variations cited above.

Refrigerant piping systems are, or at least always should be, kept perfectly clean. Although some refrigerants can cause corrosion — especially when contaminated with air, water, and fluxes from brazing and welding — corrosion and scaling never contribute significantly to friction losses in a properly maintained system.

Only Three Basic Refrigerant Conduits

There are three basic refrigerant conduits common to all refrigeration systems. These are the suction line from evaporator to the compressor, the discharge line from the compressor to the condenser, and the liquid line from the condenser through an expansion device to the evaporator. All other piping can be considered as an extension of or an auxiliary to one of these.

Suction lines receive the greatest attention, due to the pronounced direct effect of suction line pressure loss on the capacity of the compressor. Fig. 1 illustrates percentages of decrease in capacity (or increase in compressor size required to maintain constant capacity) plotted against a range of suction line pressure losses. Evaporating temperatures are shown as a parameter. It is clear from this graph that, for low temperature applications, capacity penalties are especially severe.

Systems with direct expansion evaporators and reciprocating compressors depend upon sufficient velocity in suction risers to return oil from evaporator to compressor. Theoretical reasoning backed by experience in practice indicates that, in smooth pipes, the successful return of oil is dependent on the pressure gradient due to friction in the riser or upwardly inclined pipe.

Maintain These Friction Values

The following friction pressure loss values should be maintained or exceeded when the flow rate is at its lowest value in any vertical up flow line or any line pitching up in direction of flow.

Saturation temperature	Pipe size	
	2 in. and less	Above 2 in.
50 F and above	0.25 psi per 100 ft	0.15 psi per 100 ft
0 F	0.35 " "	0.20 " "
−50 F	0.45 " "	0.25 " "

It's unfortunate that lower evaporation temperatures require higher pressure gradients since, as we have seen in Fig. 1, compressor capacity penalties due to suction line losses increase rapidly as temperature decreases.

The only way to compromise this situation and still rely on the suction line for oil return is to size the riser so that sufficient pressure gradient due to friction exists for oil return, and to minimize the actual pressure drop by making the riser as short as possible. Double risers, one with a close trap, can permit oil return at partial capacity through one riser while the second is sealed off by still oil. At full capacity there is sufficient velocity for oil return, even after the oil seal in the trap has blown. The two risers combined will not cause undue capacity penalty due to pressure loss.

There is no need for horizontal lines and downcomers to be restricted in size for oil return as long as they do not contain traps where bodies of liquid might unintentionally collect and eventually slug into the compressor.

Consider Other Methods for Oil Return, Too

There are, of course, other methods of returning oil which should be considered when too much friction loss is required for suction riser return.

Pressure losses in the suction and discharge lines result in an increased pressure ratio required of the compressor in order to meet evaporating and condensing pressure levels. Increased pressure ratio means less capacity from the compressor and more power required for the desired amount of refrigeration.

The function of the liquid line is to transport liquid refrigerant from a high pressure receiver or condenser to the low pressure evaporator. Therefore, one might suspect that friction losses in liquid lines are not particularly undesirable. In fact, some very small packaged refrigeration units use capillary tubes to feed liquid from high to low pressure for the very reason that the flow restriction eliminates the need for other flow metering devices.

However, a good majority of liquid feed controls will not function at their best (some hardly at all) if there are significant pressure losses in the liquid line leading up to the evaporator feed device. This is due in part to the decreased pressure difference existing at the expansion valve with which to exercise flow control and more significantly to the amount of flash gas which results when thermodynamically saturated liquid undergoes a pressure reduction.

Intermittent flash gas and liquid flow results in erratic expansion valve operation. Pressure energy lost to friction can cause increased flashing rather than increased flow. This appears as a "choking" of the mass flow, severely restricting the capacity of the liquid line and thus the capacity of the refrigeration system.

It is, therefore, good practice to design the liquid line in such a way as to eliminate, or at least minimize, the formation of flash gas.

If the condenser or receiver can be elevated to provide sufficient static head on the liquid line, no flashing will occur. The necessary static elevations to overcome a pressure loss of 1 psi are conservatively estimated as follows: halocarbons 2 ft; methyl chloride, 2.6 ft; and ammonia, 4 ft.

Another method is to subcool the refrigerant liquid to a temperature at least as low as the saturation temperature corresponding to the lowest expected liquid line pressure. If the liquid line rises from the receiver, the static elevation effect must be considered, as well as the friction drop when determining the lowest expected liquid line pressure. Fig. 2 illustrates the amount of subcooling required.

The most obvious way to reduce friction losses is by an increase in the line size for an established flow rate. For laminar flow (hardly ever experienced in refrigerant piping) the friction loss is proportional to the one-fifth power of the diameter. For fully developed turbulent flow, it is proportional to the one-sixth power. It is difficult indeed to effect comparable order of magnitude reductions in friction flow loss by any means other than diameter increase. However, costs of materials, installation, and insulation also increase quite rapidly with diameters. So economics often require consideration of other possibilities.

Choice of Refrigerant Affects Pressure Loss

As shown in Fig. 1, refrigerant selection has a real bearing on pressure losses due to flow. On low temperature systems, especially, this consideration can become important enough to be the deciding factor in refrigerant choice. For example, a cascade system using refrigerants Nos. 13 and 22 might be selected in favor of refrigerant No. 22 multi-stage for an application requiring long insulated suction lines. The line sizes will be smaller because there is much less cfm per ton of refrigeration to handle. Specific friction pressure losses greater than the minimum for oil return may be allowed, since the increase in suction flow rate due to friction is less with refrigerant No. 13 than with No. 22. Thus, the compressor capacity is not penalized as severely.

A Lot Can Be Done at Layout Stage

Much can be done in the system layout to minimize friction losses. Components should be arranged so that interconnecting lines are short and direct, without unnecessary fittings. Losses due to valves and fittings can often be reduced; for example, through the use of an angle valve in place of a straight valve plus an elbow, or long radius elbows in lieu of short radius elbows.

The use of a suction-to-liquid heat exchanger at the evaporator coil tends to increase the specific volume of the suction vapor. But at the same time it reduces the number of pounds per minute which must evaporate for a given tonnage. Total cfm per ton, therefore, does not change significantly. There exist, however, two advantages favoring use of such equipment on low temperature systems.

First, a higher average suction line temperature reduces the amount of heat in-leakage from the generally warmer surroundings. This increases the cfm per ton; therefore it increases the velocity and friction loss.

Second, the temperature increase in many cases is sufficient to reduce, sometimes even eliminate, the need for insulation. If money thus saved were invested in larger diameter pipe, real friction loss reductions would exist.

The proper economic choice of line sizing can only be made within the limits which will result in satisfactory operation of the system. The limits must be understood. One must be able to realistically predict the magnitude of friction pressure loss due to fluid flow and know how to change it if necessary. ±

Conference Session a Feature of ARI's Atlantic City Show

Exposition Opens November 2, Runs Through November 5. Session on November 3 To Show Importance of Air Conditioning and Refrigeration in Today's "American Way of Life"

WHAT AIR conditioning and refrigeration mean to America's way of life—and how essential they are to the health, productivity, and defense of the U. S.—will be highlighted at a conference in Atlantic City's Convention Hall at 9:30 a.m., Tuesday, November 3. This "conference session" is a special feature of the 11th Exposition of the Air-Conditioning and Refrigeration Industry, to be held in Atlantic City starting Monday, November 2, and running through Thursday, November 5.

A meeting of the members of the Air-Conditioning and Refrigeration Institute will be held November 1. Also meeting in Atlantic City at the time of the show are the Refrigeration Service Engineers Society, the Air-Conditioning and Refrigeration Wholesalers, and the National Commercial Refrigerator Sales Association.

Speakers scheduled to address the November 3 conference session are:

Joseph Rorick, assistant for planning and construction, International Business Machines Corp., who will speak as the representative of a large industrial user of air conditioning. IBM not only utilizes air conditioned factory space, but many of its products require controlled conditions of temperature and humidity for their operation.

Thomas R. Casberg, staff specialist, mechanical equipment and systems, Office of the Assistant Secretary of Defense, Properties and Installations, who is responsible for the establishment of design, construction, maintenance, and operation programs related to mechanical equipment in the far-flung Defense Department, will speak on the need for cooperation between the department and the people who produce the essential equipment for the literally thousands of applications of air conditioning and refrigeration in the nation's defense establishment. His talk also will outline broadly the Defense Department's policy on air conditioning, and is expected to refer to the department's exhibit of applications of the refrigeration cycle in the convention hall.

Arthur S. Goldman, market research director of House & Home magazine, whose discussion will be on the market for residential air conditioning, with suggestions on how this market may be developed.

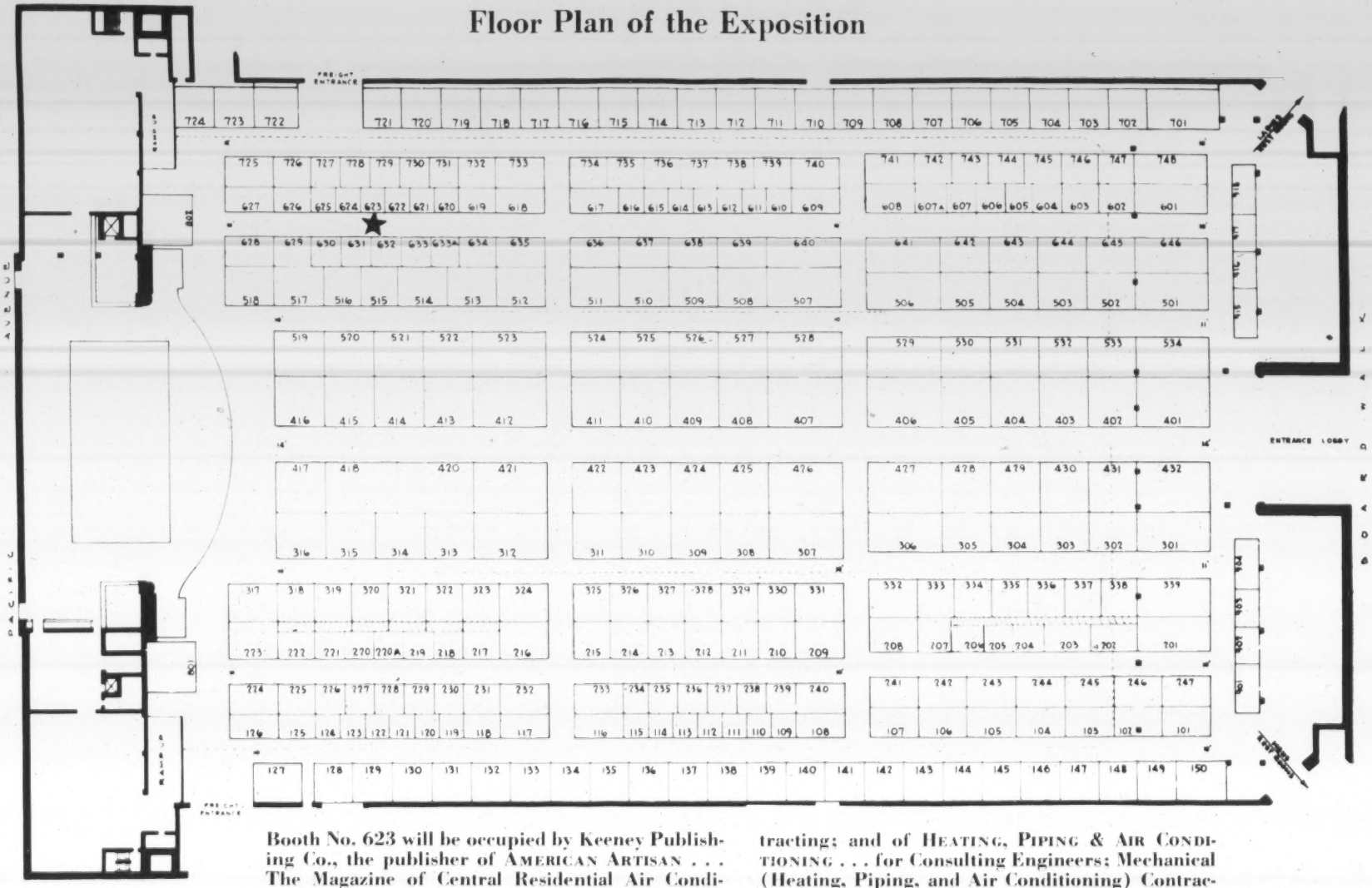
Harold J. Humphrey, president of the National Association of Frozen Food Packers, who will cover the necessity for refrigeration equipment in today's food distribution scheme.

Rudy Berg is president of the ARI, which is sponsoring both the exposition and the conference. R. H. Luscombe is chairman of the exposition committee, and R. K. Serfass, vice president of the ARI, will preside at the conference session. A complete list of the names and booth numbers of the exhibitors, together with a floor plan of the exposition showing the space locations, as furnished by the ARI and up-to-date at presstime, is published here for the convenience of HPAC's readers who plan to visit the show. Also published here are highlights of the displays that will feature air conditioning equipment and products. This information was also made available by the ARI, to whom it was reported by the various exhibitors.

Show Hours

Monday	November 2	2 p.m. to 10 p.m.
Tuesday	November 3	10 a.m. to 6 p.m.
Wednesday	November 4	10 a.m. to 6 p.m.
Thursday	November 5	10 a.m. to 4 p.m.

Floor Plan of the Exposition



Booth No. 623 will be occupied by Keeney Publishing Co., the publisher of AMERICAN ARTISAN . . . The Magazine of Central Residential Air Conditioning, Warm Air Heating, and Sheet Metal Contracting; and of HEATING, PIPING & AIR CONDITIONING . . . for Consulting Engineers; Mechanical (Heating, Piping, and Air Conditioning) Contractors; and Engineers with Plants and Big Buildings.

THE EXHIBITORS AND THEIR BOOTH NUMBERS

As furnished at presstime by the exposition's sponsor

Acme Steel Co. 619
Addison Products Co. 331
Aeroquip Corp. 234
Air Conditioning, Heating & Refrigeration News 311
Air Conditioning, Heating & Ventilating 614
Air Con Filter Co. 113
Airserco Mfg. Co. 206-7
Airtemp Div., Chrysler Corp. 335-6-7-8-9
Alco Valve Co. 523
Allen-Bradley Co. 746-47
Allin Mfg. Co. 226
Alter, Harry, Co., Inc. 120
Aluminum Foundries, Inc. 629
American Artisan 623
American Automatic Ice Machine Co., Inc. 429
American Brass Co. 410
American Coils Co. 401
Ansul Chemical Co. 417
Armstrong Cork Co. 611-12
Arrow-Hart & Hegeman Electric Co. 228
Automatic Devices Div., American Machine & Metals, Inc. 218
Avon Tube Div., Higbie Mfg. Co. 323

Bacharach Industrial Instrument Co. 624
Bally Case & Cooler Co. 632
Barr Mfg. Co. 639
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Bendix-Westinghouse Automotive Air Brake Co. 307
Betz Div., Bohn Aluminum & Brass Corp. 223
Beverage-Air Sales Co. 605
Binks Mfg. Co. 242
Bossman Controls Co. 111
Bundy Tubing Co. 309
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Carrier Corp. 413
Century Electric Co. 801
Chemical Solvent Co. 502
Chicago Reference Book Co. 124
Clark Door Co., Inc. 917
Clayton Mark & Co. 334
Coldin Cabinet Co. 722
Controls Co. of America 641-2
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Dow Chemical Co. 643
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HIGHLIGHTS OF AIR CONDITIONING EXHIBITS

HERE ARE brief descriptions of those displays that will feature air conditioning equipment, products, or supplies (as reported by the respective manufacturers to the exposition management, and furnished to the publisher by presstime.) As some exhibitors of course could not complete the requested information in time for publication, the displays themselves should be checked for other air conditioning equipment, products, and supplies that will be shown. A list of all exhibitors and their booth numbers — as furnished by the show management and complete at presstime —is published on the page facing the floor plan of the exposition.

If you turn to your right as you enter the Convention Hall and go to the far aisle, walking up and down the aisles lengthwise of the hall, you will find these descriptions of the displays in approximate order to minimize backtracking. For additional information, you are invited to inquire at Booth No. 623.

Copper and Copper Alloy Tubes . . Booths 915-16

Copper and copper alloy tubes for air conditioning and refrigeration, heat exchanger and condenser use.

Exhibitor: Lewin-Mathes Co., Div. of Cerro de Pasco Corp., 1111 Chouteau Ave., St. Louis 2.

Air Conditioning Units . . . . . Booth 918

Multizone central station air conditioning unit, "Evntemp" steam coil and cut-away model, remote room air conditioning unit and cut-away model.

Exhibitor: Marlo Coil Co., 7100 S. Grand Ave., St. Louis 11.

Tools, Valves, Fittings . . . . . Booth 748

Universal piercing valve for canned refrigerants, double-action tube bender, charging port for hermetic units, flaring tool that also burnishes, sizing tools, production flaring tools. Also, refrigerant hose and re-usable couplings, flared tube fittings, driers, "Magic Eye" liquid indicators, "Diamond" valves, tube cutters, flaring tools, tube benders, charging and testing units, charging hose, hermetic piercing valves, etc.

Exhibitor: The Imperial Brass Mfg. Co., 6300 W. Howard St., Chicago 48.

Switches, Starters . . . . . Booths 746-47

New oiltight pressure switch operating at pressures up to 5000 psi, and a new temperature switch with lower differentials and new bellows designed to provide "ten times longer life." Also, new developments in control relays, manual and magnetic starters for both full and reduced voltage applications, pilot devices and accessories.

Exhibitor: Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4.

Air Conditioning Units . . . . . Booths 708-9

Air conditioning units featuring modular construction for flexibility in arrangement in sizes from 1200 to 29,000 cfm; "Dri-Fan" factory-assembled evaporative condensers in capacities up to 233 nominal tons; electric defrost unit coolers; "Vapomatic" demonstrator.

Exhibitor: Recold Corp., 7250 E. Slauson Ave., Los Angeles 22.

Evaporative Condenser . . . . . Booth 318

Blow-through type evaporative condenser, 55 ton nominal capacity, cut apart to emphasize constructional features. Also, installation photos.

Exhibitor: The Vilter Mfg. Co., 2217 S. First St., Milwaukee 7.

Engine Driven Compressors . . . . . Booth 626

Engine driven refrigeration compressors, 1 through 6 tons; condensing units; engines; portable and mobile electric generating plants.

Exhibitor: D. W. Onan & Sons Inc., University Ave., S.E. at 25th, Minneapolis 14.

Instruments, Recorders . . . . . Booth 624

"Floret" air velocity indicator, "Tempscribe" two pen temperature-operation recorders, "Monoxor" quantitative CO analyzer, sling psychrometers, air filter gages, air filter service switch. Also, bi-metal and remote temperature recorders, "Florite" air velocity meters, "Fyrite" testing kits, mercury and dial thermometers, gas pressure manometer.

Exhibitor: Bacharach Industrial Instrument Co., 200 N. Braddock Ave., Pittsburgh 8.

High Vacuum Pumps . . . . . Booth 631

Compound high vacuum pumps for dehydration of sealed systems before introducing refrigerants. Also, high vacuum gage.

Exhibitor: F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20.

Humidifier, Air Filters . . . . . Booth 633

New aerosol-atomizing humidifier for domestic, commercial and industrial applications. Also, permanent, washable air filters for furnaces, room coolers, and central air conditioning systems.

Exhibitor: Skuttle Mfg. Co., Milford, Mich.

Publications . . . . . Booth 623

"Heating, Piping & Air Conditioning," magazine for consulting engineers, mechanical (heating, piping, and air conditioning) contractors; engineers with plants and big buildings. "American Artisan . . . The Magazine of Central Residential Air Condition-

ing, Warm Air Heating, and Sheet Metal Contracting," "Air Conditioning" newsletter; reprint books; marketing information.

Exhibitor: Keeney Publishing Co., 6 N. Michigan Ave., Chicago 2.

Stud Drivers . . . . . Booth 633-A

Stud driver equipment.

Exhibitor: Remington Arms Co., Inc., Bridgeport 2, Conn.

Blower Housings, Stampings . . . . . Booth 634

"De-Sta-Co" blower housings, flapper valves for compressors, special plates and flanges, variety of unique stampings.

Exhibitor: Detroit Stamping Co., 350 Midland Ave., Detroit 3.

Compressor Rack Kits . . . . . Booth 619

New "AIM Brand" slotted single compressor rack kits, which include precisely cut lengths of galvanized cold-rolled steel slotted angle for each type of rack, diagram and instructions, wooden supports, nuts, bolts and lock washers. Also slotted angle for custom-built racks, mounts and supports for control boards, piping, ducts and cooling towers.

Exhibitor: Acme Steel Co., Fabricated Materials Div., 135th & Perry Ave., Chicago 27.

Starters, Motors . . . . . Booth 635

Demonstration unit showing operation of four-step increment (part winding) starter for use with squirrel-cage motors to obtain low inrush of current at start; demonstration unit showing quiet operation of a 10 hp resilient mounted squirrel cage motor. Also, standard fractional and integral motors, jet pump and belted drive fan motors, single- and three-phase hermetic motors.

Exhibitor: Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 33.

Air Curtain, Condensing Units . . . Booths 616-17

Air curtain, hermetic condensing units, belt-driven condensing units, receivers and receiver-condensers.

Exhibitor: Lehigh Mfg. Co., 1500 Lehigh Dr., Easton, Pa.

Relief and Other Valves . . . . . Booth 615

Ammonia relief valves, liquid oxygen valves, shut-off valves, expansion valves, check valves, purge valves, three-way valves, 300 lb malleable iron fittings.

Exhibitor: Cyrus Shank Co., 4646 W. 12th Pl., Chicago 50.

Defrost Controls . . . . . Booth 638

Defrost control with adjustable fail safe protection, time initiated-pressure terminated; defrost control with adjustable fan delay for hot gas, electric heat and water spray defrosting.

Exhibitor: Paragon Electric Co., 1600 12th St., Two Rivers, Wis.

Magnetic Starters, Contactors . . . . . Booth 613

New "Class 41" magnetic contactor designed for air conditioning and refrigeration service, rated 20, 30 and 40 amp in 2, 3 and 4 poles, and available as open type or in general purpose enclosures. New design magnetic starters, rated 20, 30, 35 and 50 amp, feature all front removable components, dual voltage coils reconnectable in the field, trip-free thermal overload units with trip indicator. Also, magnetic starters and contactors through 400 hp, 550 v and related pilot devices.

Exhibitor: Furnas Electric Co., 1000 McKee St., Batavia, Ill.

Insulation Finish . . . . . Booths 611-12

Newly developed highly flexible plastic finish designed for "Armaflex" pipe insulation. Also, pipe insulation, sheet insulation, "Armalite" insulation, "Insulcolor," "Monoplast," "Plasticork," adhesives and sundry materials.

Exhibitor: Armstrong Cork Co., Insulation Div., Lancaster, Pa.

Driers, Solder, Flux . . . . . Booth 610

New molecular sieve driers with large screen areas and brass shells; silver solder flux in plastic bottle; heavy duty driers; capillary tubes; strainers and driers; piercing valves; silver solder and flux; cap tube drier; strainer combinations.

Exhibitor: Wabash Corp., 2300 S. Western Ave., Chicago 8.

Valves, Controls . . . . . Booth 609

New three-way valve for fan-coil unit water control, new control package for fan-coil units. Also, solenoid valves for refrigerants (liquid, suction and hot gas), water, air, light oil, other fluids.

Exhibitor: Jackes-Evans Mfg. Co., Controls Div., 4427 Geraldine Ave., St. Louis 15.

Expansion Valves, Solenoids . . . . . Booths 641-2

"Flat-Top" thermostatic expansion valve designed for use in heating and air conditioning units; new "Trap-Dri" with silica gel and molecular sieve; demonstration units of hot gas defrost operations and applications of pressure regulating valves for room coolers. Also, "A-P" expansion valves, solenoid valves, and regulating valves; "Redmond" motors and blowers.

Exhibitor: Controls Co. of America, 2450 N. 32nd St., Milwaukee.

Insulation, Pipe Covering . . . . . Booth 643

Display will be devoted to use of "Styrofoam" in low temperature insulation and pipe covering, and will feature the exhibitor's "approved contractor" program which is aimed to assure quality installation and quality insulation.

Exhibitor: The Dow Chemical Co., Midland, Mich.

Lubricated Plug Valves . . . . . Booth 604

Lubricated plug valves.

Exhibitor: W-K-M Div. of ACF Industries, Inc., P. O. Box 2217, Houston 1.

Unit Air Conditioner . . . . . Booth 644

New 15 hp unit air conditioner arranged with bypass damper to provide humidity control. Also, "Eclipse" compound or two-stage compressor, models of "Presthin" and "Spiral-fin" coils, valves, fittings, machine parts.

Exhibitor: Frick Co., Waynesboro, Pa.

Protective Devices, Controls ..... Booth 601

Protective devices for hermetic compressors, of enclosed thermostat design mounted on the windings inside the hermetic enclosure. Also, "Klixon" service parts, starting and protective devices for compressors, controls made by the Spencer Products Group, and metals and materials made by the General Plate Group.

Exhibitor: Metals & Controls Div., Texas Instruments, Inc., 34 Forest St., Attleboro, Mass.

Controls ..... Booth 501

Complete line of automatic controls for air conditioning and refrigeration, including thermostats, temperature and pressure controls, and air conditioning control panels.

Exhibitor: White-Rodgers Co., 1209 Cass Ave., St. Louis 6.

Refrigerants ..... Booth 534

"Genetron" refrigerants.

Exhibitor: General Chemical Div., Allied Chemical Corp., 40 Rector St., New York 6.

Expansion Valve ..... Booth 503

New expansion valve with inspection window. Also, solenoids, other expansion valves, air conditioning controls.

Exhibitor: Detroit Controls Div. of American-Standard, 5900 Trumbull Ave., Detroit 8.

Driers, Heat Exchangers ..... Booth 532

"Little Giant" all-purpose molecular sieve driers, heat exchangers, steel accumulators. Also, OEM driers, strainers, accumulators, capillary assemblies, etc., and driers, strainers and capillary assemblies for servicemen, including "Kap-Kit" and other specialty items.

Exhibitor: Kenmore Machine Products, Inc., 15 Depew Ave., Lyons, N.Y.

Receivers, Condensers ..... Booth 504

Heat pump receivers, booster receivers, F.F. receivers, large capacity shell and tube condensers. Also, vertical and horizontal receivers, shell and coil condensers.

Exhibitor: Standard Refrigeration Co., 3535 Fillmore, Chicago.

Finned Coils, Unit Coolers ..... Booths 529-30

New finned coils and unit coolers. Also, exhibitor's complete line.

Exhibitor: Tenney Engineering, Inc., 1090 Springfield Rd., Union, N.J.

Refrigerants, Chemicals, Oils ..... Booth 528

Refrigerants, water chemicals, insulation and sealing materials, refrigeration oils.

Exhibitor: Virginia Smelting Co., West Norfolk, Va.

Coils, Cooling Tower ..... Booths 524-5-6

Air conditioning coils, cooling tower, remote air cooled condenser, unit coolers.

Exhibitor: Larkin Coils, Inc., 519 Memorial Dr., S.E., Atlanta.

Compressors ..... Booths 510-11

New "CL30" 3 hp, 2-pole air conditioning compressor featuring a built-in anti-slugging device and internal overload. Also, cut-aways and representative models of air conditioning line of pancake compressors and special heat pump compressors.

Exhibitor: Tecumseh Products Co., Tecumseh, Mich.

Controls, Control Center ..... Booth 512

Control panels, heat pump sequencing devices, residential weather station control center, heating and cooling thermostats, dirty filter indicator.

Exhibitor: Minneapolis-Honeywell Regulator Co., 2747 Fourth Ave., S., Minneapolis 8.

Solenoid and Other Valves ..... Booth 523

New line of high pressure solenoid valves for refrigerant 22, recent improvements in full line of solenoid valves, developments in new change-over valves, cut-aways and animation of thermo and solenoid valves. Also, latest designs in series for direct expansion, suction pressure regulators together with new version of pilot control including evaporator pressure regulators. Venturi flow distributors. Thermo expansion valves with and without pressure limiting feature.

Exhibitor: Alco Valve Co., 865 Kingsland Ave., St. Louis 30.

Air Cooled Condensers ..... Booths 513-14

Line of air cooled condensers, ranging in nominal sizes from 1 to 60 tons, these ratings being based on a 20 F difference between entering air and condensing temperature. Also, floor type industrial units, unit coolers.

Exhibitor: Refrigeration Appliances, Inc., 923 W. Lake St., Chicago 7.

Copper Tube ..... Booth 519

New packaging concept for copper refrigeration service tube for wholesaler distributors, comprising a round carton with center hole to facilitate handling and storing and that can be used as a reel. Also, long-length copper coils; "Tap/Trap" air chamber; "Trufin" integrally finned tube; "Capilator" capillary tube; extruded and drawn aluminum tube; commercial copper tubing; "Spun End Process" for strainers, driers, accumulators; other fabricated parts.

Exhibitor: Wolverine Tube, Div. of Calumet & Hecla, Inc., 17200 Southfield Rd., Allen Park, Mich.

Moisture Indicators, Refrigerants .... Booth 417

New "Super Dry-Eye" moisture indicators, "Ucon" brand refrigerants. Also, driers, drier manifolds, receiver driers and receiver moisture indicators, sight glasses, oil, packaged refrigerants.

Exhibitor: Ansul Chemical Co., Marinette, Wisc.

Roof-Top Air Conditioning Unit .... Booth 418

"Melco" roof-top air conditioning unit providing heating and cooling for single-story buildings. Also, "Compact-A-Metic" compressor rack units.

Exhibitor: Melchior, Armstrong, Dessaut Co., 730 Grand Ave., Ridgefield, N.J.

Expansion and Solenoid Valves . . . . . Booth 421

Thermostatic expansion valves, solenoid valves, refrigerant distributors, "Catch-All" filter-driers, "See-All" moisture and liquid indicators, "Level-Master"—for liquid level control.

Exhibitor: Sporlan Valve Co., 7525 Sussex Ave., St. Louis 17.

Aluminum Coils, Sheets . . . . . Booth 412

An all aluminum air conditioning coil; finished parts used in air conditioning and refrigeration and made by customers of the exhibitor; new high-brilliancy alloy 5457, "Satin-Tex" sheet, and patterned sheet.

Exhibitor: Kaiser Aluminum & Chemical Sales Inc., 1924 Broadway, Oakland, Calif.

Valves, Sight Glasses, Accessories . . . Booth 411

Valves, sight glasses, heat exchangers, driers, filters, strainers, manifolds, fittings, accessories.

Exhibitor: Superior Valve and Fittings Co., 1509 W. Liberty Ave., Pittsburgh 26.

Flexible Metal Tubing . . . . . Booth 410

New "AX" large diameter flexible metal corrugated tubing assemblies designed to handle axial and lateral movements while conveying large volumes of liquids or gases, and flexible tin-bronze "Anaconda" vibration eliminators for high pressure applications. Also, restrictor tubes; long coils of capillary tubes; general display of small diameter tubing; flexible metal hose assemblies of monel, stainless steel, steel and aluminum; as well as "Sealtite" conduit and "Flexpipe."

Exhibitor: The American Brass Co., Waterbury, Conn.

Water Regulators, Solenoid Valves . . . Booth 409

Combination R-12 R-22 water regulators; three-way water regulators, ½ to 4 in.; temperature actuated water regulators; motorized water regulators; temperature compensating back pressure regulators. Also, complete line of solenoid valves and back pressure regulators, including cut-aways and operating models.

Exhibitor: Refrigerating Specialties Co., 3004 W. Lexington Ave., Chicago 12.

Fin and Refrigeration Tubing . . . . . Booth 408

"Readi-Fin" integral fin tubing, "Readi-Pak't" refrigeration tubing.

Exhibitor: Reading Tube Corp., 2301 Empire State Bldg., New York 1.

Conditioners, Compressors . . Booths 422-3-4-5-6

Direct drive condensing units and compressors, industrial hermetic units and motor-compressors, 20 hp "Brunnermetic" compressors, rooftop conditioners, "Plasti-Deck" cooling towers, low silhouette blower condenser, blow-through evaporative condensers. Also, shell and tube inner fin condensers, air handling units, air cooled condensers, various types of air conditioners, coils, centrifugal pumps, specialties and circulators, other products.

Exhibitor: Dunham-Bush, Inc. (including Brunner Div. and Heat-X subsidiary), 179 South St., West Hartford, Conn.

Air Conditioners, Compressors . . . . Booth 407

New "V-line" compressor, packaged liquid chiller using new compressor, 25 ton air or water cooled package unit, fan coil room air conditioner, 10 ton ceiling hung blower coil unit, 10 ton air cooled condensing unit, new electric furnace humidifier, new complete winter air conditioning unit, self-contained heat pump unit, split system heat pump unit, humidity control air conditioner, remote coil and blower unit, air cooled condensing unit.

Exhibitor: Worthington Corp., Mueller Climatrol and AC&R Divs., Worthington Ave., Harrison, N. J.

Driers, Liquid Indicators . . . . . Booth 406

Large capacity driers, angle refillable driers, "Vuemaster" moisture and liquid indicators. Also, refrigeration valves, copper tube, liquid indicators, heat exchangers, accessories.

Exhibitor: Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.

Air Conditioners, Coils . . . . . Booth 427-8

Ceiling mounted air conditioners, floor mounted air conditioners, residential air conditioning evaporators, OEM air conditioning and refrigeration coils, vertical air flow air cooled condenser, unit coolers, defrost systems.

Exhibitor: McQuay, Inc., 1600 Broadway St., N.E., Minneapolis.

Seamless Copper Tubes . . . . . Booth 404

Seamless copper tubes specially tempered for air conditioning and refrigeration applications, and seamless copper tubes in continuous lengths up to 1500 ft.

Exhibitor: Viking Copper Tube Co., 16700 St. Clair Ave., Cleveland 10.

Refrigerant Dessicants . . . . . Booth 403

New "Microtraps" refrigerant dessicant, a miscoselective adsorbent material developed especially for removing low concentrations of moisture from refrigerants. Also, silica gel high capacity refrigerant dessicants.

Exhibitor: W. R. Grace & Co., Davison Chemical Div., Baltimore 3.

Air Conditioning, Furnaces, Coils . . . . Booth 402

New "Luxaire" air handling blower and cooling coil units with capacities of 34,000 and 55,300 Btu per hr, new counterflow add-on cooling coils with capacities of 36,000 and 56,500 Btu, new line of four gas fired horizontal furnaces with 80,000 to 140,000 Btu per hr inputs and approved for high air deliveries and static pressures for year 'round air conditioning installations, new factory assembled and wired upflow gas fired winter air conditioning units with 175,000 and 200,000 Btu per hr inputs. Also, air cooled condensing units, upflow and horizontal cooling coils, gas and oil fired winter air conditioning units, gas fired unit heaters.

Exhibitor: The C. A. Olsen Mfg. Co., Elyria, Ohio.

Air Conditioning, Furnaces, Coils . . . Booth 402

New "Monerief" blower-coil air handling units with 34,000 and 55,300 Btu capacities; new add-on counterflow cooling coils with 36,000 and 56,500 Btu per hr capacities; new gas fired horizontal furnaces with 80,000, 100,000, 120,000, and 140,000 Btu per hr inputs; new factory assembled and wired winter air conditioners with 175,000 and 200,000 Btu inputs. Also, plenum type and duct type evaporator coils, air cooled condenser-compressor units, gas and oil winter air conditioners, gas unit heaters.

Exhibitor: The Henry Furnace Co., Medina, Ohio.

Air Conditioners, Chillers . . . . . Booth 401

New roof mounted air cooled air conditioners, in range of sizes 5 through 20 hp, comprising air cooled condensing unit, air handling unit, and gas-fired duct furnace assembled in one cabinet. New air cooled, self contained packaged liquid chillers, sizes 3 through 20 hp, fully assembled, factory charged and wired. Also, heat pumps, air and water cooled condensing units, air cooled residential condensing units, air cooled condensers and cooling towers.

Exhibitor: American Coils Co., Route 524, Lakewood Rd., Farmingdale, N.J.

Refrigerants . . . . . Booth 432

"Freon" refrigerants.

Exhibitor: E. I. du Pont de Nemours & Co., Inc., 10th and Orange Sts., Wilmington, Del.

Water Treatment . . . . . Booth 904

"Biocide," condenser cleaner, "Micromet" plates, scale remover, algaecide, powdered acid, liquid ice machine cleaner, ice machine treatment, "Banox."

Exhibitor: Calgon Co., Div. of Hagan Chemicals & Controls, Inc., Hagan Bldg., Pittsburgh 30.

Dehumidifiers . . . . . Booth 302

Dehumidifiers, water coolers.

Exhibitor: Elco Mfg. Co., 265 N. Hamilton Rd., Columbus 13, Ohio.

Condensing Units, Heating Units . . . . Booth 303

"Airvec" convection-cooled condensing units for motels and hotels, zone controlled packaged heating units, tube-in-tube chiller units. Also, motorized zone control valves, coaxial water cooled tube-in-tube condensers.

Exhibitor: Edwards Engineering Corp., 101 Alexander Ave., Pompton Plains, N. J.

Tubing, Bellows, Valves . . . . . Booth 304

Copper refrigeration and air conditioning tubing, capillary and other precision drawn ferrous and nonferrous metal tubing, metal bellows and expansion compensators, valves, plain and anodized aluminum fin stock, continuously anodized aluminum strip in coils.

Exhibitor: Fromson Orban Co., Inc., 261 Madison Ave., New York 16.

Steel Tubing . . . . . Booth 334

Steel tubing, tested electronically and hydraulically by "Mark-Test." Also, examples of applications.

Exhibitor: Clayton Mark & Co., 1900 Dempster St., Evanston, Ill.

Air Conditioners, Chillers . . . . . Booth 306

"Spotaire" fan-coil units for horizontal and for vertical air flow. "Capitolaire" water chiller, 1960 model of "Capitolaire" packaged air conditioners, "National-U. S." water chiller. Also, heating-cooling operating display featuring boiler, chiller, fan-coil unit and controls.

Exhibitor: Heating & Air Conditioning Div., National-U. S. Radiator Corp., 944 Ash St., Johnstown, Pa.

Motor-Compressors . . . . . Booth 307

"Ovaline" air conditioning motor-compressors ranging from 5000 to 15,000 Btu per hr. Also, 3 hp and 4 hp air conditioning motor-compressors, and hermetic condensing units.

Exhibitor: Bendix-Westinghouse Automotive Air Brake Co., 950 E. Virginia St., Evansville 11, Ind.

Valves, Fittings, Accessories . . . . . Booth 308

Valves, manifolds, compressor valves, liquid indicators, sight glasses, fittings, and accessories.

Exhibitor: Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh 22.

Evaporators, Condensers . . . . . Booths 327-8

Aluminum and copper "Roll-Bond" evaporators and condensers.

Exhibitor: Roll-Bond Products, Metals Div., Olin Mathieson Chemical Corp., East Alton, Ill.

Dehydrant, Leak Detector . . . . . Booth 326

"Thawzone" fluid dehydrant, "Trace" liquid leak detector, "Leak Lock" joint sealing compound.

Exhibitor: Highside Chemicals Inc., 10 Colfax Ave., Clifton, N. J.

Relays, Controllers . . . . . Booth 325

New motor starting relays; complete line of air conditioning magnetic controllers, including relays and contactors; potential motor starting relays; power relays; general purpose multi-pole switching relays; time delay relays; hermetic overload protectors; 3 hp compressor controller.

Exhibitor: R-B-M Controls Div., Essex Wire Corp., 131 Godfrey St., Logansport, Ind.

Compressors, Condensing Units . . . . Booth 324

Refrigerant compressors, package liquid coolers, motor compressors, condensing units, heat transfer equipment, centrifugal pumps, air conditioning and refrigeration components.

Exhibitor: Bell & Gossett Co., Morton Grove, Ill.

Controls . . . . . Booth 312

Control with high electrical rating for air conditioning and refrigeration applications; controls with wide differentials and fixed setting arrangement for air conditioning and refrigeration applications; sequence timer for defrosting; reversing valves; de-icer controls for year 'round comfort with dehumidification, cooling and heating; commercial controls.

Exhibitor: Ranco Inc., 601 W. 5th Ave., Columbus 1, Ohio.

Steel Tubing . . . . . Booth 323

"Fusionbrazed" steel tubing now being made by exhibitor's Fulton Tubing Co. Div. and available in sizes from 3/16 to $^3/_8$ in. OD inclusive. Tubing is double wrapped hydrogen brazed with copper finish on ID and OD, is also available with a terne coated OD for corrosion resistance. Samples of fabricated tubular assemblies and electrical heating sheathed type elements made from steel tubing will also be displayed.

Exhibitor: Avon Tube Div., Higbie Mfg. Co., 4th and Water Sts., Rochester, Mich.

Polystyrene . . . . . Booth 319

"Dylite" expandable polystyrene for use in air conditioning and refrigeration.

Exhibitor: Koppers Co., Inc., Plastics Div., Koppers Bldg., Pittsburgh 19.

Steel Tubing . . . . . **Booth 317**

A complete automotive air conditioning condenser featuring a flattened serpentine of steel tubing. Also, various other applications of steel tubing.

Exhibitor: Rochester Products Div., General Motors Corp., 1000 Lexington Ave., Rochester 3, N. Y.

Electric Motors . . . . . **Booth 801**

Complete line of re-rated motors, 1/20 to 150 hp.

Exhibitor: Century Electric Co., 1806 Pine St., St. Louis 3.

Humidifiers . . . . . **Booth 224**

Space and in-duct humidifiers for industrial plant applications; duct type and portable humidifiers for residential use. Also, humidity controls and indicators.

Exhibitor: Walton Laboratories, Inc., 1186 Grove St., Irvington 11, N. J.

Air Conditioning Units . . . . . **Booth 223**

Air conditioning unit available with steam, water and direct expansion coils; residential evaporators for installation above or below a furnace, and for duct installation; suction line heat exchangers with straight through connection; unit coolers; product coolers; air cooled condenser with "Sensitizer" for winter operation.

Exhibitor: Bohn Aluminum & Brass Corp., Betz Div., 1625 E. Voorhees St., Danville, Ill.

Balancer . . . . . **Booth 221**

Jet room balancer.

Exhibitor: Viking Air Products, 5601 Walworth Ave., Cleveland.

Sight Glasses . . . . . **Booth 226**

New moisture-reactor "Liquid Eye" indicators. Also, standard line of "Liquid Eye" indicators and other components.

Exhibitor: Allin Mfg. Co., 410 N. Hermitage Ave., Chicago.

Motor Controls . . . . . **Booth 228**

Definite purpose contactors (25 amp, 2 and 3 pole) for use on 2, 3 and 5 hp inherently protected hermetically sealed compressor motors, and designed to meet the needs of 85 percent of the residential central air conditioning market. Definite purpose 40 amp contactors for use on inherently hermetically sealed motors. Fused pull-outs (2 and 3 pole, 30 and 60 amp) for fused protection. Also, 30 and 50 amp air conditioning and refrigeration starters and contacts, manual magnetics, starters, pushbutton controls.

Exhibitor: Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Conn.

Condensers . . . . . **Booth 230**

Refrigeration condensers.

Exhibitor: Kirsch Co., Refrigeration Products, 309 N. Prospect Ave., Sturgis, Mich.

Fan Coil Unit, Chillers . . . . . **Booth 233**

"Conceal-X" heating and cooling fan coil unit, water chillers, universal "K" surface, baseboard coils, fin coils, unit coolers.

Exhibitor: Peerless of America, Inc., 5800 N. Pulaski Rd., Chicago 46.

Self-Sealing Couplings . . . . . **Booth 234**

Self-sealing couplings.

Exhibitor: Aeroquip Corp., 300 S. East Ave., Jackson, Mich.

Leak Detector, Motors . . . . . **Booths 212-15**

New leak detector for highly contaminated atmospheres, new standard leak detector, new leak detector with proportioning probe. Also, display of hermetic motors, and complete line of capacitors and fractional hp motors for the air conditioning industry.

Exhibitor: General Electric Co., Schenectady, N. Y.

Fittings and Assemblies . . . . . **Booth 236**

Wrought fittings, headers and manifolds, return bends, condenser parts, tube fittings, strainers, assemblies, spun parts, custom bent tubes, accumulators.

Exhibitor: Elkhart Products Corp., 1255 Oak St., Elkhart, Ind.

Wrought Iron . . . . . **Booth 237**

New "Mn" wrought iron, a specialty alloy containing approximately 1 percent manganese and having improved impact resistance at subzero temperatures, designed for service where brittle failure poses engineering and design problems. Also "4-D" wrought iron and plate, having about 25 percent more corrosion resistance than standard wrought iron. Visitors to booth will try to guess the life of a section of wrought iron pipe taken from actual service.

Exhibitor: A. M. Byers Co., Clark Bldg., Pittsburgh 30.

Compressor Opener . . . . . **Booth 238**

Hermetic compressor opener designed to automatically open any hermetic compressor up to 20 in. diameter, regardless of position of weld or shape of compressor.

Exhibitor: Frankell Mfg. Co., Inc., 862 Newark Ave., Jersey City 6, N. J.

Tubing Insulation . . . . . **Booth 211**

Closed cell tubing insulation and various extruded shapes and forms.

Exhibitor: Rubatex, Div. of Great American Industries, Inc., Bedford, Va.

Air Conditioners, Chillers . . . . . **Booth 209**

Packaged air conditioners, through 60 tons; packaged liquid chillers, through 125 tons; air and water cooled condensing units.

Exhibitor: Curtis Mfg. Co., Refrigeration Div., 1905 Kienlen Ave., St. Louis 33.

Electric Motors . . . . . **Booth 240**

Integral and fractional polyphase motors with inherent thermal protection; fractional multi-speed blower units, 1800/1200 rpm, for use with heating and cooling coils; resilient mounted 2 hp motor. Also, standard line of integrals to 300 hp and standard line of fractionals.

Exhibitors: Howell Electric Motors Co., Howell, Mich.; Kingston-Conley, Inc., Plainfield, N. J.; Ohio Electric Mfg. Co., Maple Heights, Ohio.

Receivers, Filter-Driers . . . . . **Booth 208**

New receivers, "Bull Dog" filter-driers featuring zoned filtration, new suction accumulators, capillary and drier assemblies. Also, heat exchanges, mufflers, accumulator-driers, strainers, fabricated tubes, receiver-driers.

Exhibitor: Refrigeration Research, Inc., Brighton, Mich.

Cooling Towers . . . . . Booth 242

"Watertemp" cooling towers in capacity range from 5 to 60 tons, and new heavy duty "Watertemp" construction, capacity range 80 to 300 tons. Also, complete line of industrial nozzles for industry-wide applications.

Exhibitor: Binks Mfg. Co., 3100 W. Carroll Ave., Chicago 12.

Compressor Analyzer, Testing . . . . Booths 206-7

Six new instruments for hermetic compressor analysis and electrical testing and demonstration of high vacuum pump for dehydrating, degassing and leak testing systems. Also, portable charging stations, panels and cylinders; psychrometers and thermometers; calculators; thermostatic control tester; electronic sound tracer; refrigerant and vacuum hoses and quick couplers; air meters; high and low vacuum pumps.

Exhibitor: Airserco Mfg. Co., Inc., 435 Melwood Ave., Pittsburgh 13.

Dampers, Grilles . . . . . Booth 204

Fire damper that carries Underwriters' Laboratories label, new "Ful-Flo" grille used for exhausts and outdoor air intakes. Also, parallel and opposed blade dampers, fire dampers, extruded and adjustable louvers, door louvers, shutters.

Exhibitor: Imperial Damper Co., 664 Edgecombe Ave., New York 32.

Fans, Electric Heating . . . . . Booths 202-03

New six blade, one piece condenser fan and slinger ring; new four blade, heavy duty fan, 20 to 42 in. diameters, for package and split system air conditioners, cooling tower and attic fan applications; line of domestic electric heating equipment, including baseboard, wall, portable and bathroom heaters, and ceiling cable.

Exhibitor: Meier Electric, 3525 E. Washington St., Indianapolis.

Capacitors . . . . . Booth 246

New, improved terminals for motor-start and motor-run capacitors, "Mike-O-Meter" motor capacitor tester, motor-start and motor-run capacitors, "Koolpak" capacitor assemblies, adequate wiring analyzer.

Exhibitor: Sprague Electric Co., Marshall St., North Adams, Mass.

Tube, Brazing Alloy, Wire . . . . . Booth 247

Drawn copper and copper base alloy tube, straight and coiled; integral fin-tube, straight and formed; drawn aluminum, straight and coiled, plain and anodized; low temperature brazing alloy; drawn copper, copper alloy, and aluminum wire.

Exhibitor: United Wire & Supply Corp., 1497 Elmwood Ave., Providence, R. I.

Valves, Instruments . . . . . Booth 201

New line of solenoid valves, piping and duct thermometers, "Master Test" test gages. Also, "Serviceman" line of testing gages and thermometers, pressure and temperature operated water regulating valves, gages, needle valves.

Exhibitor: Marsh Instrument Co., Div. of Colorado Oil and Gas Corp., 3501 W. Howard St., Skokie, Ill.

Electric Heating Elements . . . . . Booth 101

Electric heating elements for the air conditioning and refrigeration industries.

Exhibitor: Electro-Therm, Inc., 931 Selim Rd., Silver Spring, Md.

Condensers, Cooling Towers . . . . . Booths 149-50

"DriCooler" air cooled refrigerant condensers, now being produced in capacities nominally rated from 15 through 100 tons, displayed with low temperature control features; initial announcement of evaporative condenser of new type. Also, packaged cooling towers of three basic types — "Aquatower," "AquaCooler," and "Permatower."

Exhibitor: The Marley Co., 222 W. Gregory, Kansas City 14, Mo.

Motor-Compressors . . . . . Booths 139-40-1-2-3

New 4 and 6 cylinder, 7½ hp low temperature through 25 hp high temperature, "Copelametic" motor-compressors; 2½, 3, 3½, 4 and 5 hp "Copelaweld" motor-compressors; ⅛, 1/5, ¼ and 1/3 hp "Copelaweld" motor-compressors and condensing units; air cooled and water cooled "Copelametic" condensing units of new compact design; belt-driven condensing units.

Exhibitor: Copeland Refrigeration Corp., Sidney, Ohio.

Tube Benders . . . . . Booth 114

"Handy" tube benders for copper, steel and iron tubing or pipe.

Exhibitor: Holsclaw Bros., Inc., 408 N. Willow Rd., Evansville, Ind.

Filter-Driers, Accessories . . . . . Booths 115-16

New line of filter-driers, aluminum filter-driers for aircraft service, special gas driers for high pressure service, electronic gas detoxifiers, oxygen filters, storage tank indicating dry air breathers, instrument air dehydrators. Also, hermetic liquid indicators, liquid and suction filters, water regulating valves, charging hoses, tube clamps, mounting straps, flexible pull-out hoses.

Exhibitor: The McIntire Co., Okner Pkwy., Livingston, N. J.

Charging, Testing Unit . . . . . Booth 117

Recently introduced charging and testing unit. Also, tube piercing valves, charging lines, driers, strainers, capillary tubing, swivel tees, and flare tube fittings.

Exhibitor: Madden Brass Products Co., 700 Sheffer Rd., Aurora, Ill.

Water Treatment . . . . . Booth 119

New model of feeder, other larger models, related chemicals.

Exhibitor: Stiles Karlsonite Corp., 1550 Grand Ave., Waukegan, Ill.

Leak Detector . . . . . Booth 120

Electronic leak detector will be demonstrated testing for leaks on a refrigeration unit. Also, a display of general interest featuring old-time catalogs.

Exhibitor: The Harry Alter Co., Inc., 1721 S. Wabash Ave., Chicago 16.

Electric Shear, Tools . . . . . Booth 122

Electric shear with capacity up to 16 gage in steel, and 17 gage in stainless, which will give minimum left-hand radius of ½ in. and minimum right-hand radius of 1 in.; "Dymo" line of diamond drilling equipment for holes up to 6 in. diameter will be introduced; new line of circular saws will be featured. Also, "Sawzall" and blades, right angle drills, electric hammers, sander-grinders, screw-drivers, chain saws, generators, and polishers.

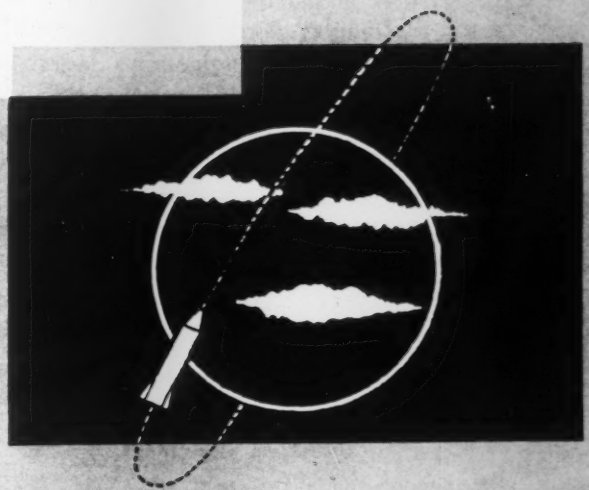
Exhibitor: Milwaukee Electric Tool Corp., 5316 W. State St., Milwaukee 8.

HPAC ENGINEERING DATA FILE

Environmental Control Key to Success of the Manned Earth Satellite

. . . air conditioning vital to astronauts

By Herbert H. Christman



When man is flung into space in an orbital vehicle, every possible factor in his environment will have been accounted for in the design of the space vehicle cabin. The design of this environment falls largely to the air conditioning engineer experienced in environmental control — including heating, air conditioning, and ventilation. Early participation of the air conditioning engineer in the design of space vehicles is important to assure that structural considerations do not impose severe limitations and hazards on the space traveler.

In this report, prepared exclusively for Heating, Piping & Air Conditioning, the author presents factors that must be considered in design to provide a space crew with an acceptable environment. Important ones include oxygen supply and pressurization, evaluation of the heating and air conditioning loads, and reduction of cosmic radiation. In addition to discussing each of these variables, some system design concepts for controlling each are given. In particular, some of the air conditioning systems that can satisfy the requirements of an orbital vehicle are presented. These are preliminary considerations and represent current thinking on the subject. In a field where obsolesence through research occurs overnight, specific systems for meeting the exacting control, low weight, and reliability demanded in an orbiting vehicle may change markedly before the first man is placed in orbit. However, the basic considerations will remain the same.

The author — who presently shares the design responsibility for the Thor IRBM ground support air conditioning — is a designer in the thermo-conditioning group of the missiles division of Douglas Aircraft Co. He was graduated with a bachelor of mechanical engineering degree from Rensselaer Polytechnic Institute in 1951. Since that time he has held a number of positions in the air conditioning field, ranging from application engineering to sales and including design and test responsibility for the high velocity duct sections in the Boeing 707 jet transport. He is a registered professional engineer.

Environment Control in Earth Satellite Vehicles

"Inevitable in the hostile void of space is the need for temperature and humidity control."

THE NOW well known X-15 research vehicle begins a program which will gradually lengthen a series of manned elliptical flight paths to half way around the world. Its successors will orbit earth. This orbiting could be accomplished by mid 1961 if re-entry techniques are perfected and the whole man machine system works out.

The Air Force Man-In-Space program which originally was scheduled to put a manned satellite into a 200 mile orbit by the end of 1959, has been taken over by the National Aeronautics and Space Administration. Full scale prototypes for this program have already been assembled to NASA specifications. Big Joe, one such prototype, was recently fired to a height of 100 miles and successfully recovered.

These projects—bolstered by information to be gained from at least a dozen preliminary shoots with animal carrying vehicles, some of them recoverable—are an effort to bring man into early participation in the successive stages of space flight, including its risks. This will result in knowledge of human science keeping pace with vehicle science.

At the moment, so little is known of man in space, there will be no certainty of survival until every human part and process is reduced to a state of performance and control, predictable within reasonable tolerances. The first ventures of man into space are not daring aeromedical feats. They are experiments to confirm and supplement exhaustive laboratory investigation.

With the advent of missiles, man was considered phased out of the Weapon Mission concept. In a complex non-weapon space effort, the rationality of man must be included as a hedge against contingencies, for equipment maintenance and, eventually, for exploration. Initially man will go along mainly "just for the ride". As the implications of the manned earth satellite are understood more fully and exploration is extended, crew functions will be highly selective. They will include interpretation of data, follow up action and final judgments far beyond the "intelligence" capability of the vehicle's machine components.

Man's attendance at this stage will also offset the disjointed approach of structure oriented design groups from subordinating crew function and survival which has proven inadequate in solving past problems of manned flight. Notable items on the record are: toxic environment resulting from combustion and fluid leakage fumes; frost, condensation, and fog in the cockpit due to inadequate and uneven environment control and system capacity; clothing obstruction to adequate ventilation and easy freedom of movement; rudimentary or non-existant solution to elimination and feeding needs; instrument displays seriously limiting

pilot response and ability; the frequent physical impossibility of maintaining control command; a maze of manual navigation aids; little or no fire protection, and lastly, the dramatic episodes resulting from inadequate crew escape until long after the advent of supersonic aircraft.

Despite the extensive cabin ecology studies (studies of the mutual relations between organisms and their environment) conducted in the laboratories and at relatively high altitudes on man and animals, many human factors won't be resolved except under true out-of-atmosphere conditions. These factors involve human reaction to satellite cabin isolation, prolonged weightlessness, high accelerations, and, nourishment and waste elimination.

With the evolution of interplanetary flight, there will sooner or later come the problem of establishing orbital vehicles whose size, weight, and structural limitations prevent them from being fired into their orbits in one piece. Among their many functions, large earth satellite vehicles (ESV's) will be necessary as bases for the refueling and even the construction of long distance interplanetary vehicles and orbit to surface ferries. The degree of their importance in refueling will depend on the development of more powerful fuels and motors. The station will be a laboratory for cosmic and ultraviolet ray research, high vacuum studies and zero gravity therapy. It will be a test facility for the life support systems eventually to be used in manned space probes.

Until a solar or atomically powered robot satellite can be relied upon to remain operating for several decades, meteorological surveillance will depend upon crew maintained equipment. Currently, between 5 and 10 percent of the earth's surface is under weather study. A vehicle in a 4000 mile polar orbit would circle the globe every four hours at a speed relative to the earth of 6000 mph. Scanning the entire earth's surface, with its changing cloud covers and moving fronts, will furnish coded information to ground computers that will accurately forecast weather conditions for days and possibly weeks ahead. The benefits of storm warning alone would sanction the cost of orbital surveillance.

A large ESV is too vulnerable to enemy action and too full of tactical shortcomings to be justifiable on purely military grounds. One vehicle proposed by W. von Braun, whose design is commensurate with the present state of the art, would orbit at 1075 miles, weigh somewhat over 400 tons and require 7000 ton, three stage launch rockets, each bearing 36.5 tons of useful payload. This station, of the rotating wheel type for gravity simulation, is typical of present thinking. A station of this kind would be self-sufficient for months with a closed cycle ecological system. The following are some of the design factors that would be involved in the environmental control system.

Consider Oxygen Supply and Pressurization

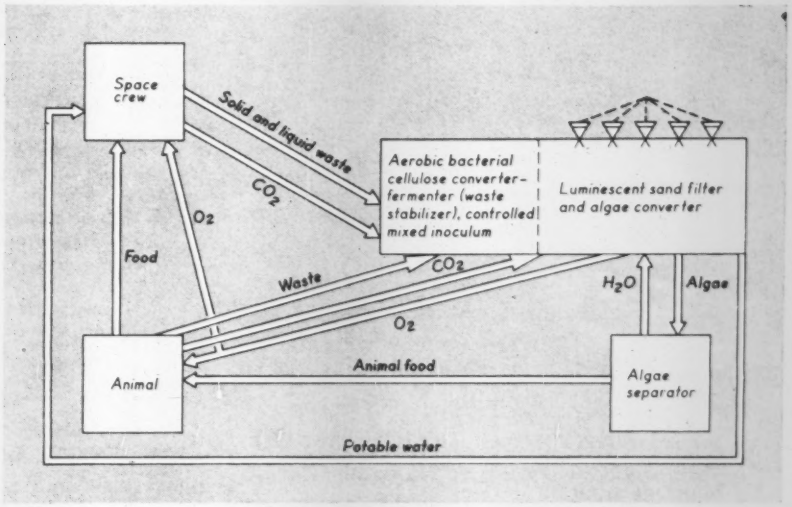
Affording an adequate environment begins with providing oxygen. Man can stay alive for weeks without food, days without water, but only minutes without oxygen. Second is the need for carbon dioxide removal. The biochemical means to do these and other life support functions are now available for a space journey of several weeks. Canned food, oxygen tanks, chemical carbon dioxide absorbers, and chemical waste disposers were in the closed cabin in which an airman recently lived for a week.

Algae Can Supply Oxygen, Food

The earth satellite vehicle, however, will have to be self-sufficient since it will be contacted at intervals of three to six months and then primarily for crew rotation. The greatest promise for this long a conditioning period is the closed algae cycle, as shown in Fig. 1. This would be supplemented by oxygen from a liquid reservoir to offset any inherent or meteoritic leakage.

A research program is now under way to perfect the closed ecological system. A gas exchange system has been built in which algae successfully produced the oxygen needed by four white mice whose exhalations provided carbon dioxide for the minute plants' photosynthesis. Further experiments use urea as the algae nutrient.

Algae would provide a food source, also, in the form of a protein rich "soup" or "pudding". If the space man turns up his nose at this fare, it



1 ALGAE-bacteria-plant-animal regenerative cycle shown schematically can supply oxygen, water, and food for space crews while accomplishing waste removal functions — including absorption of respired carbon dioxide. Pilot studies indicate that such a system is feasible though present systems require considerable power and are cumbersome. The cycle shown here includes an optional algae nourished animal element to make space rations more palatable. An additional refinement would include higher plants grown hydroponically on the bacterial-algal filter converter. Lights above filter converter provide illumination for algae growth

could be rendered more appetizing by feeding it to slugs, snails, or water fleas. Another possibility is microbe protoplasm with artificial flavoring.

The crew will require nutrients such as vitamins, fats, carbohydrates, amino acids, proteins, minerals, bulk, and water. Algae is deficient in many respects, such as cysteine, methionine, histidine, and vitamin D, and would need supplements. The cycle from which oxygen would be evolved incorporates solid and liquid waste recovery, conversion, reconstitution and reconstruction into palatable food. Present approaches at the laboratory level require relatively large amounts of power, weight, and volume. Since it is the most promising answer, miniaturization, compaction, and high yield formulations must be involved in the final apparatus.

Future potentialities of algae as a staple are good. They are composed of 50 percent protein, 15 percent carbohydrate, 25 percent lipoids, and 10 percent ash. Digestibility is high and loss in food preparation would be almost zero. Organic byproducts are small as is the number of dead cells in a growing suspension.

Algae such as chlorella pyrenoidosa are single celled, small round bodies about the size of a red blood cell. They do not have the specialized organs of higher plants, so the photosynthetic process can be fully utilized for oxygen production and growth. This can continue endlessly if light and nutrients are plentiful without the alternate light and dark phases required by higher plants.

Experiments have shown that 5 lb of algae can produce enough oxygen and absorb enough carbon dioxide to meet the needs of one man. In long duration tests, optimum light intensity for growth and oxygen production was found to be 500 foot candles. This is low compared with the 10,000 fc sunlight available at sea level.

Anacystis nidulans, a blue green alga found in Texas ponds, has a potential oxygen evolution three times greater than chlorella, providing it is illuminated three times as intensely. Little is now known of other limitations of anacyctis. It may be that a mixture of the two algae would give optimum performance to weight.

Another new strain of algae has recently been developed which has over 100 times the growth rate of chlorella. If practicable in other respects, a 4 in. thick solution of this type, at $2\frac{1}{2}$ sq ft per crewman, would be adequate. The most serious limitation to algae of this type is its tendency, if killed or damaged, to release carbon monoxide.

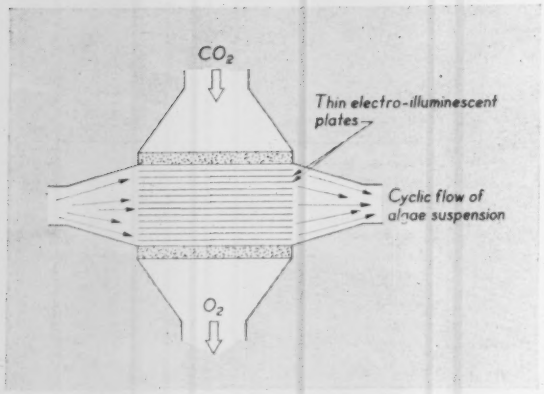
The hydroponic algal tanks (vessels in which plants are grown without soil with their roots immersed in a solution of water and nutrients) would be supported by:

1) A means of illumination (artificial or solar or both) with a controlled spectrum most suitable for the desired reaction

2) A means of aeration (cabin air can be bubbled through the suspension)

3) Cell density measurement (probably photometric)

4) A means of circulation and causing turbu-



2 PHOTO-SYNTHETIC gas exchanger may be used to convert respired carbon dioxide to oxygen. This is a part of the cycle shown in Fig. 1. Such an exchanger will eliminate the need for chemical absorption -- except for emergencies — with its attendant regeneration requirements. Carbon dioxide removal from the vehicle atmosphere is as essential as oxygen supply to prevent deleterious respiratory effects of excessive carbon dioxide partial pressures

lence of the bacteria-algae suspension

5) Nutrient addition devices

6) A harvesting mechanism (probably centrifugation).

The first two requirements could be met with a compact gas exchanger (shown in Fig. 2) utilizing layers of thin electro-illuminescent plates which could generate light at low rates of heat dissipation.

Full Pressurization Has Advantages

Full pressurization reliability should remove the need for a standard oxygen supplemental mask which, besides being a nuisance to wear, would require 1200 cu ft of oxygen or two ¾ cu ft converters which weigh more than 200 lb and include no safety factor. Moreover, an average value of 1 cfh or 2 lb of oxygen per day must be available.

Less than 5 percent of the gas respired through a standard mask or helmet system is utilized for metabolism. The remaining discarded gas would make the cabin atmosphere gradually approach the composition of the source and would require more than 20 times the gas volume than if the subject merely breathes cabin atmosphere.

A full pressure suit will be used only in emergencies. If the oxygen partial pressure should drop below 2 psi undetected, hypoxia—the effect of too little oxygen—results. Its onset is insidious. There is no warning, no pain. Instead, there occurs a gradual decrease in mental agility and activity resulting in fatigue, drowsiness, and sluggishness. Coordination and visual acuity are lost, along with the crewman's most precious asset, his ability to analyze and self-evaluate critically. If prolonged, the result is nausea, headache, collapse, coma, and, ultimately death.

How to Remove Carbon Dioxide

Preliminary design studies indicate that a chemical air regeneration system for emergency carbon dioxide removal should weigh no more than 15 lb per crewman. Experience gained from submarine practice establishes 3 percent carbon dioxide as an upper limit for relatively short term exposure. A limit of 1 percent is more conservative for the long exposure anticipated in space vehicles to preclude any personnel efficiency loss.

The average 175 lb man would liberate about 0.9 cu ft of carbon dioxide for each 1 cu ft of oxygen used. Therefore, about 2.5 lb of carbon dioxide would have to be removed per man-day. Oxygen consumption and carbon dioxide production for 10 crewmen are shown in Tables 1 and 2, respectively.

For removing carbon dioxide, mechanical freeze-out techniques require much more total equipment weight and operational power than chemical absorbent systems. Such a system would use an exterior radiator heat sink and a solar heat collector for selective gas vaporization.

Anhydrous lithium hydroxide is the most efficient carbon dioxide absorber. Only 1-1/3 lb of LiOH, compared to 3 lb of baralyme or soda lime, is needed to absorb 1 lb of CO_2. LiOH is porous and nondeliquescent, but will pick up 5 to 6 percent water at 35 percent relative humidity in a highly exothermic reaction. This hydration is undesirable because it impairs CO_2 absorption. The disadvantages of LiOH are its high price and tendency to dust.

TABLE 1 — OXYGEN CONSUMPTION at five different rates for a crew of 10 men

O_2 rate, cu ft per man-hr	Oxygen consumption for 10 men					
	per day		per month		per year	
	cu ft	lb	cu ft	lb	cu ft	lb
0.8	192	15.9	5,760	478	70,080	5,820
0.9	216	17.9	6,480	538	78,840	6,540
1.0	240	19.9	7,200	598	87,600	7,270
1.2	288	23.9	8,640	717	105,120	8,720
1.4	336	27.9	10,080	837	122,640	10,180

TABLE 2 — CARBON DIOXIDE production at five different rates for a crew of 10 men

CO_2 rate, cu ft per man-hr	Carbon dioxide production for 10 men					
	per day		per month		per year	
	cu ft	lb	cu ft	lb	cu ft	lb
0.7	168	19	5,040	580	61,320	7,020
0.8	192	22	5,760	660	70,080	8,020
0.9	216	25	6,480	740	78,840	9,030
1.1	264	30	7,920	910	96,360	11,030
1.3	312	36	9,360	1,070	113,880	13,040

TABLE 3 — OXYGEN CONCENTRATION needed to maintain 95 percent blood saturation for indicated cabin equivalent altitudes, total cabin pressures and oxygen partial pressures

Equivalent altitude, ft	Cabin Pressure, psi		Oxygen concentration, percent
	Total	O_2 partial	
Sea level	14.70	3.08	21
5,000	12.23	3.06	25
10,000	10.11	3.14	31
15,000	8.29	3.31	40
20,000	6.75	3.31	49
25,000	5.45	3.37	62
30,000	4.36	3.53	81
34,000	3.62	3.62	100

Algae Absorb Carbon Dioxide

The function of algae for photosynthetic removal of carbon dioxide is as important as its oxygen production. Chlorella can absorb all CO_2 present, when aerated with a 5 percent mixture. The CO_2 in expired air is about 4 percent. In a 100 cu ft compartment, if CO_2 is allowed to accumulate from one person without removal, it will reach 5 percent in approximately 3 hr. Since CO_2 accumulation and toxicity becomes a problem in about half the time as does the dwindling oxygen supply, the former aspect of algal ability is foremost.

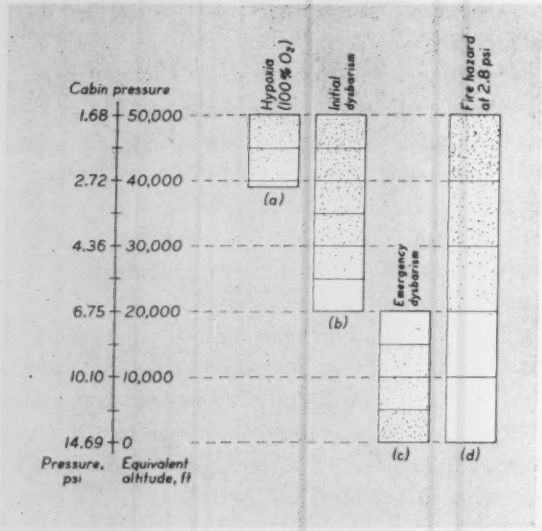
Photosynthetic reduction of CO_2 would be relied upon primarily, but could not be substantially accelerated. This process would proceed at a constant rate, since it is geared to oxygen evolution and the artificial ultraviolet radiation provided to the algae. Since dangerously high CO_2 concentrations would require quick reduction, supplementary absorbents are necessary.

The minimum nonhypoxic oxygen partial pressure, although a highly variable factor, is generally considered to be 2.9 psi for extended exposures. This value is in pure oxygen. Oxygen partial pressures required for 95 percent blood saturation — the average sea level concentration — are given in Table 3.

Problems of Subatmospheric Pressures

The occurrence of "bends" without extensive oxygen prebreathing may become a serious consideration with cabin pressures between 5.5 and 7.5 psi, depending on the amount of physical exertion. An emergency partial pressure helmet will provide a pressure of about 2.9 psi. Navy submarine practice has established a maximum pressure change ratio of 2:1, without danger of bends. On this basis, maximum permissible cabin pressure is 5.8 psi; i.e., the 5.8 to 2.9 psi pressure change does not exceed a 2:1 ratio. Emergency and initial dysbarism are shown in Fig. 3. Dysbarism is the symptom resulting from a decrease in total atmospheric pressure. Instantaneous decompression to a hard vacuum would result in unconsciousness within 5 to 7 seconds.

Cabin decompression can be caused by exhausted pressure accumulators (liquid oxygen and nitrogen cryotanks, supplemented with glass fiber gas bottles), mechanical failure, leaky seals, structural leaks due to thermal or mechanical stress, or meteorite collision. Intentional decompression may be effected to explore the outside of the vehicle, perform repair work, transfer logistic supplies, or to blow noxious or toxic gases overboard. Experiments show that, barring catastrophe, decompression time will be long enough to allow a crewman to don a suit, admit a high volume short duration surge of pure oxygen to the cabin, or enter an air lock. Compartmentation against severe damage, combined with rapid detection



3 PARTIAL PRESSURE OF OXYGEN and total pressure in a sealed cabin depend upon several factors illustrated here. These must be considered when designing the cabin environment. Shading density on bars increases with increased hazard to the space traveler. The conditions of importance in selection of pressures are: (a) hypoxia — caused by too little oxygen — shown here with a 100 percent oxygen atmosphere (oxygen partial pressure is cabin total pressure), (b) initial dysbarism — caused by exposure to subatmospheric pressures, (c) emergency dysbarism — resulting from rupture of cabin or other accidental rapid decompression, (d) fire hazard caused by increasing oxygen concentration as a result of decreasing total pressure with partial pressure of oxygen held constant at sea level value of 2.8 psi

and sealing of small leaks, will preclude full recourse to pressure suits.

Leak detection will be two-fold: through the automatic measurement and comparison of gas flow to each compartment and the monitoring of cabin aneroids referenced to vacuum outside.

The purpose of the suit, apart from enveloping the crewman's atmosphere, is to provide the counter pressure to prevent the pooling of blood in the extremities. In addition to ordinary expansion of gases in the ear, sinus, and intestine, dissolved nitrogen is released in the blood and tissues. If severe, this leads to central nervous system collapse. Ebullism, or boiling of body fluids, occurs at about 0.9 psi total pressure, corresponding to 63,000 ft altitude (sometimes referred to as the Armstrong line). This is the commonly accepted value for water vapor pressure and generally represents the demarcation line for the onset of ebullism; ungarmented occupancy would be fatal even if decompression was gradual.

There is a structural advantage in not exceeding the minimum practical total pressure. With a given skin stress and compartment diameter, skin thickness varies directly with internal pressure. A low total pressure would represent a weight saving where skin thickness was chosen on structural rather than cosmic ray shielding considerations.

In addition to the question of dysbarism because of evolved gas, a low pressure atmosphere must be rich in oxygen. As this atmosphere approaches 100 percent oxygen, fire hazard increases, as shown in Fig. 3. At a total pressure of 5 psi, combustion is half again more rapid than in a standard atmosphere. Anything that will burn at ground level will burn more rapidly at high altitudes at the same oxygen partial pressure.

Use Inert Gas to Raise Total Pressure

To increase total pressure at a given oxygen concentration, some inert diluent may be used — probably nitrogen or helium. The rate of diffusion of helium is 2.57 times greater than that of nitrogen. However, greater mobility is not realized because the gas exchange rate in the body is determined almost exclusively by the rate of tissue perfusion by the blood. Fatty tissue contains about five times as much dissolved nitrogen as the blood. On the other hand, helium is only about half as soluble as nitrogen. Furthermore, the solubility of helium in fat tissue is about the same as in nonfat.

The upshot of this is that the body of a man breathing helium-oxygen mixtures contains far less dissolved gas than if he were breathing nitrogen-oxygen. A curve prepared for underwater diving but applicable to the dysbarism problem suggests that a 50 percent helium and 50 percent nitrogen mixture would present less dysbarism hazard than either of the above. The increased heat conductivity of helium has the advantage of improved internal heat transfer and the disadvantage of higher heat loss or gain through the outside wall by conduction.

A helium-oxygen mixture influences communication because it changes voice timbre and elevates pitch by half an octave. In addition, helium's higher diffusivity would make it harder to contain against leakage. Until more experimental evidence is available, there is no overwhelming advantage to an atmosphere of half oxygen and half nitrogen, or one of equal parts oxygen, helium, and nitrogen. The oxygen-nitrogen mixture would be easier to obtain. Properties of helium, nitrogen, argon, and air are shown in Table 4. Exclusive of decompression, the best compromise between all factors would be a 50 percent oxygen atmosphere at a total pressure of about 7 psi — the pressure found at 20,000 ft.

Another benefit of an inert diluent has been brought to light. Six men spent seven days in a compartment containing approximately four times the normal oxygen concentration and experienced little ill effect. This experiment was prompted by the difference of opinion regarding the maximum oxygen percentage to which humans could safely be subjected. All the men experienced a reduction in vital lung capacity (maximum amount of air that can be exhaled after a maximum inhalation) and two showed signs of slight oxygen toxicity.

Oxygen pressure within the chamber was kept at 8.4 psi and nitrogen at 2.1 psi. This compares with 3.0 psi and 11.7 psi, respectively, at standard atmosphere. In other words, oxygen comprised 80 percent of the test atmosphere, whereas it makes up about 20 percent of the normal atmosphere.

The reduction of vital capacity may be due to folding of the air sacs of the lungs, because a large lung area is not required at such a high oxygen level. An inert gas would keep the sacs distended. This concentration of oxygen is close to the top limit to which man can be safely subjected over a prolonged period of time. This is significant since it defines the upper control limit for concentration.

TABLE 4 — PHYSICAL PROPERTIES of air and three inert oxygen diluents

Property	Gas			
	Air	Argon	Helium	Nitrogen
Density at 14.69 psi and 68 F, lb per cu ft	0.0753	0.1037	0.0104	0.0727
Density relative to air	1.000	1.377	0.138	0.966
Gas constant R, ft per R deg	53.30	38.70	386.30	55.16
Specific heat (C_p) at room temperature, Btu per lb per F	0.241	0.124	1.250	0.247
Normal boiling point, F	−317.6	−302	−452	−320
Density of liquefied gas, lb per cu ft	57.4	87.3	9.18	50.4
At temperature, F	−233	−303	−456	−321
Critical temperature, F	−220.3	−187.7	−450.2	−232.8
Critical pressure, atmospheres	37.2	48.0	2.26	33.5

Factors in Air Conditioning Load Determination

Inevitable in the hostile void of space is the need for temperature and humidity control. Cabin temperature will be determined primarily by the radiation exchange between its outer surface and the radiant sources contained in a solid angle of 4π steradians from it. Although the temperature equivalent molecular velocity is high, as shown in Fig. 4, the background of space can be considered as a radiation sink with a temperature of about −460F.

The vehicle will need special radiating surfaces to dissipate excess heat generated by equipment, components, auxiliary power, and human metabolism. The waste heat will be transferred to these surfaces by an intermediate fluid, such as mercury. The surface emissivity (white, black, or metallic) of the radiator and its orientation with respect to the sun and earth will determine whether heat is added or removed from the system.

Fig. 5 shows a vehicle energy balance. The equilibrium temperature will depend on the heat capacity of the surface (insulation and thermal lag), and the flight path which determines the duration of exposure to direct solar radiation or earth reflection or both.

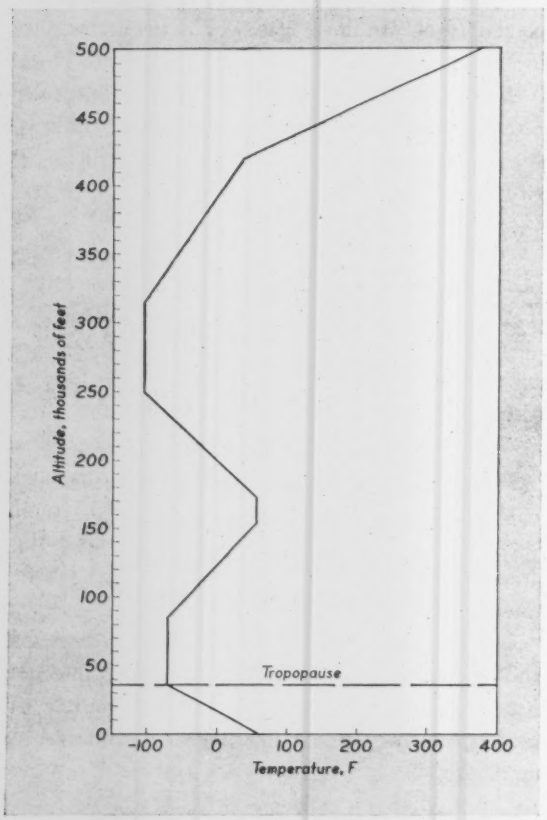
Internal temperature pickups in the Vanguard and Explorer satellites indicated their internal equilibrium temperatures in space were not at radical extremes. By analogy, capacities should be moderate.

Sources of Internal Heat Gain

The amount of heat produced by a 175 lb

crewman using 3000 calories per day would be about 12,000 Btu per day. This rate assumes a daily schedule of sleep, moderate work, leisure and programmed exercise. The vehicle would require the service of a physicist, meteorologist, astronomer, chemist, biologist, electronic engineer, metallurgist-machinist, two space medicine physicians, and a combination vehicle system engineer-navigator-captain. Consequently, the station would be manned by a crew of about 10 men, their aggregate total heat rejection being about 5000 Btu per hr.

Most internal heat would originate in a paraboloidal solar collector, or in batteries during eclipsing or in a nuclear reactor. Until such time as certain nuclear reactor shielding problems are solved, the sun will supply the bulk of power requirements. It has the advantages of constant availability, uniform capacity, minimum takeoff weight, high reliability power distribution, and nontoxic byproducts.



4 PROFILE of Air Research and Development Command model atmosphere shown above indicates molecular velocity rather than heat transfer capability because of low density of air at high altitudes

Equipment load would consist largely of sensors — the payload of the vehicle. These would be electromagnetic, optical, inertial, force, geometric, quantitative, and chemical. In conjunction with a computer, they would automate the vehicle and, where required, feed into a display for the crewman to make a decision. Power plant waste heat would be outside the conditioned atmosphere and hence not add to the load.

Illumination would be the fourth and smallest source of heat. Artificial illumination will be used since, apart from the discomfort of glare from windows, the unprotected eyes risk injury in both the infrared and ultraviolet range.

Short term heavy exposure to infrared radiation (as from atomic heat flash or looking directly into the sun through a telescope) can produce a retinal burn; long term moderate irradiation leads to the type of cataract once seen in steel furnace men.

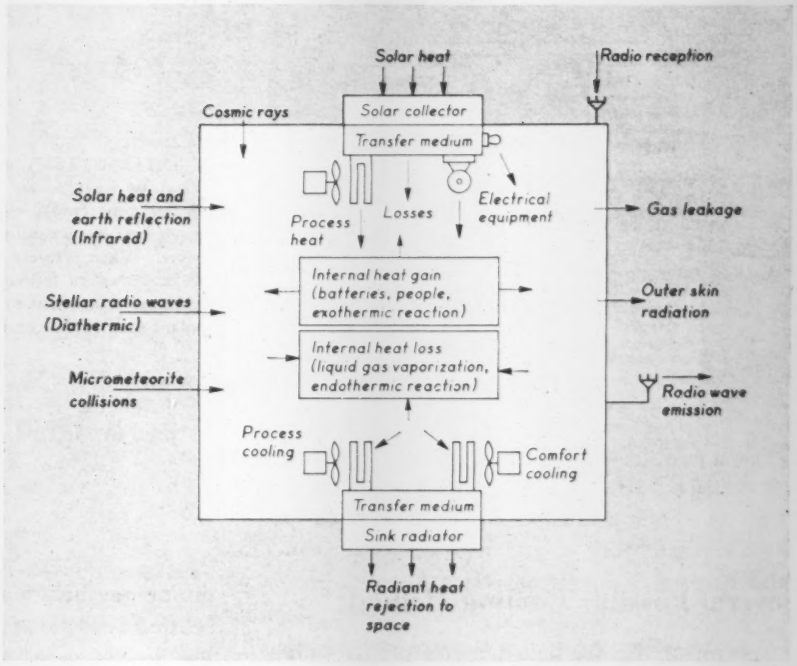
Ultraviolet radiation can blister the skin and also produce a temporary but very painful burn of the cornea (snow blindness). Even if the eye is directed away from direct sunlight, ultraviolet light striking the eye obliquely causes a fluorescence in the lens, making darkness even more impenetrable.

The high intensity lamps for algae growth could be immersed in the hydroponic fluid, or recessed in troffers and close-coupled to exterior radiators to bypass their heat around the temperature control system.

Air Conditioning Necessary

Even though there would be 400 "degree-days" per day, internal heat production would exceed that required to maintain a comfortable cabin temperature. An outside radiator would reject the excess. This could be controlled by changing the radiator emissivity, such as with adjustable shutters polished on one side and dull black on the other. It would be assumed that maintenance procedures would offset the dulling effect of meteorite erosion, if this proves to be a problem. Present estimates, based on Explorer II meteorite impact detectors, indicate that reflectivity will be reduced by one-half in about five years. This coincides with normal obsolesence period.

A comparable feat was performed by Picard as early as 1931 when he painted one side of his balloon gondola black and left the other shiny.



5 HEATING and air conditioning load of an earth satellite vehicle consists of many components shown here in energy balance on cabin. Internal heat generation will probably be great enough to require cooling for personnel comfort even though solar radiation gains are controlled by varying surface absorptivity and are offset by radiation losses to space from the outer skin

However, the rotation mechanism failed with the black side toward the sun and the temperature inside the gondola rose over 100 F.

As a rough guide, where outside surface emissivity is not controlled, the effect of internal heat generation is slight if the heat generated per square foot is less than the solar energy input, i.e., on the order of 34 Btu per sq ft of vehicle surface. Equilibrium temperature rises markedly only when internal heat goes much higher than 34 Btu per sq ft.

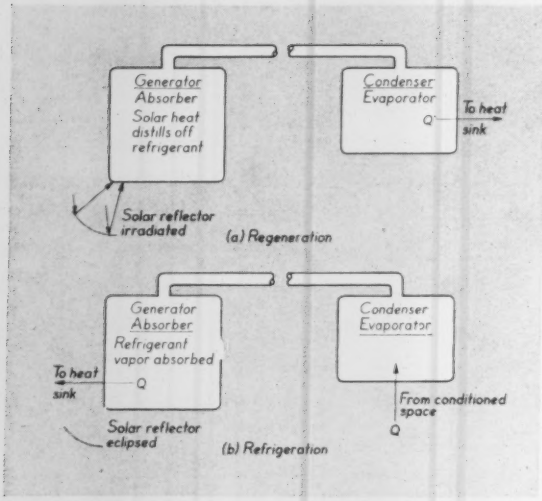
Conversely, vehicle design becomes a factor since, for high internal loads, it pays to increase the vehicle's cross-section (and surface area) up to the point where internal heat approximates solar input. In addition, radiant heat loss and gain (−460 F on the dark side and 300 F on the sunlit side) will depend on wall construction for design protection against cosmic radiation and meteorites. The probability of one or more evacuated annular spaces between concentric, hermetic shells would prove a good insulator.

Changes in sun orientation of the vehicle in any given single orbit will be masked by thermal lag. For a few weeks of the year, a toroidal vehicle in a polar orbit (the most likely path) will have its solar input reduced to less than half. This can be compensated by heat exchanger capacity control.

Air Conditioning System Design Concepts

Temperature and humidity conditions would be zoned. Equipment areas could be held at 100 to 125 F, personnel quarters at 65 to 85 F, and the hydroponic tank room at 90 to 100 F. Other areas would receive only relief cooling to provide a minimum of excess capacity, in the interests of weight saving.

Certain local processes will need close temperature control. Photographic development, for example, will require a 68 F ($\pm\frac{1}{2}$ F) bath. Distillation of urine requires close temperature control to prevent boiling and resulting carryover of constituents. These and other specific fluid temperatures will be maintained through three-way mixing, with high reliability pneumatic thermostats, valves, etc., using 15 psi throttled nitrogen for actuation. This would be preferable to balanced bridge electric or electronic circuits.



6 INTERMITTENT absorption cooler shown schematically can be used to air condition a satellite vehicle. With vehicle sunlit (top), system is regenerated as lefthand component acts as generator and righthand component as condenser. When vehicle transits earth's shadow (bottom), system cycles as lefthand component acts as absorber and righthand component as evaporator to absorb heat from the coolant used in the conditioned space

Several Possible Cooling Methods

Control of the dry bulb temperature to within 65 to 85 F can be provided by pumping a cooling fluid to the external sink. To cut down the heat exchanger size requirement, the energy level of the fluid can be raised, using a cooling system based on solar regeneration.

This system, illustrated in Fig. 6, essentially consists of two interconnected vessels which form an intermittent or batch process absorption cycle. During refrigeration, one vessel is the evaporator and the other the absorber. Gaseous refrigerant travels to the absorber vessel and goes into solution. During regeneration, the absorber and evaporator become the generator and condenser, respectively.

The advantages of such a system are that there are no moving parts, reliability is high, and regeneration and refrigeration can be accomplished intermittently as the vehicle is alternately irradiated by the sun and eclipsed by the earth. Where the orbit plane is normal to solar radiation, cycling would be achieved by timed orientation of the solar reflector.

An ammonia-water absorption system is most satisfactory. There will be no toxic danger, since the system is hermetically sealed and self-contained. Refrigerant No. 22 and glycol-ether are also a feasible refrigerant-absorbent combination.

In tests, the cooling ratio of the system (heat absorbed by the refrigerant during refrigeration divided by the heat absorbed by the generator during regeneration) was about 1:3. The solar heating ratio (heat absorbed by the generator during regeneration divided by the incident solar radiation on the collector) was about 1:2. These figures can be substantially improved. A maximum performance ratio of 30 percent might be realized.

A second possibility for refrigeration, though more remote in view of application problems, would be based on new thermo-electric materials. Heat could be absorbed in a cold junction by passing current through the junction. Some cooling effect could be realized by the continual flashing of liquid atmosphere constituents to gas. But this would be slight in proportion to requirements.

A method of cooling at light loads that would satisfy the problem of air distribution as well as minimize secondary cosmic radiation would be to recirculate the cabin air through the annular, interwall area where it would approach the average wall temperature. It would then be introduced through mixing diffusers to equipment, where it would be reheated and discharged to occupied areas.

Dehumidify by Mechanical Means

Dehumidification would occur close to the common return air manifold to prevent wall frosting. Waste treatment and algal tank compartments would be separately zoned. The rest of the cabin would have a small latent load — less than 3000 Btu per hr.

Humidity control could be performed by a small central mercury heat exchanger coupled to an external heat exchanger that could be either a sink or solar collector, depending on its orientation. Such a device could either control supply air dewpoint for dehumidification, or supplement reheat during equipment shutdown. Condensate would be gravity filtered and returned to the fresh water supply. Zones of low controlled humidity will be kept at lower dry bulb temperature, also. The rate of increase of vapor pressure to temperature is 40 times as much at 150 as at 40 F.

Chemical moisture absorption will not be used, so as to fully utilize existing equipment and to avoid reactivation of absorbent.

Moist Air Properties at Low Pressure

The reduced pressure will affect humidity comfort sensation. Where the dry bulb temperature is constant, the amount of moisture per pound of dry air varies almost inversely as the ratio of the barometric pressure. This is true at saturation or at any given relative humidity. Consequently, any environment having a certain dry bulb, dewpoint, and relative humidity will not have these values changed by a pressure change — even though the wet bulb temperature and absolute humidity will be different.

For the most part, the wet bulb lines and lines of constant total heat are parallel. Where this is not the case, as in the higher range of temperatures and relative humidities, the increase in grains per pound of dry air is heightened at low pressures.

While the crewman's vasomotor mechanisms will maintain a uniform deep tissue temperature as he moves between temperature differences, his awareness of the change, as measured by skin temperature adjustment, would last twice as long at 80 percent RH as at 30 percent. This fact, added to the need for condensation control and respiratory health, suggests a maximum relative humidity of 40 percent. This gives a comfortable compromise with supply air dewpoint, reheat requirement, and personnel tolerance.

At reduced total pressure and for any given dewpoint and dry bulb temperature, the relative humidity and grains per cubic foot will be the same as at sea level. But, since moisture is usually expressed as grains per pound of dry air, moisture content will vary inversely as the total pressure — having the effect of raising the equivalent sea level *effective temperature* 1 or 2 F. This effect will combine with cardio-vascular-metabolic reactions to subgravity-oxygen environment to fix the temperature control point. One consequence of the rise in effective temperature will be to offset the mean radiant temperature of the wall, if it is cooled by supply air.

Odor and Dust Removal

The problem of odor removal is mostly esthetic. The first physiological effect of the emission of stomach and intestinal gases in a 100 cu ft cabin, is tearing of the eyes due to hydrogen sulfide. It would take 2000 days of exposure to reach fatal H_2S levels. Skatole, indole and sulphate odors associated with waste treatment can be minimized by recirculation through activated carbon and ultraviolet irradiation. Additional odor removal will be accomplished by scrubbing in the algae tanks.

Dust flotation due to reduced gravity will be offset by filtration with submicron particulate filters, necessary because of the laboratory environment. Power supplies available to other equipment may make electrostatic precipitation possible. Good air filtration will minimize decompression

TABLE 5 — MAXIMUM ALLOWABLE CONCENTRATION of some propellant fuels and oxidizers as airborne contaminants

Substance	Threshold limit values ACGIH[a] 1959	
	ppm[b]	oz per 1000 cu ft[c]
Ammonia	100	0.069
Aniline	5	0.019
Ethyl alcohol	1000	1.900
Ethylene oxide	50	0.090
Heptane	500	2.000
Isopropyl alcohol	400	0.980
Methyl alcohol	200	0.260
Nitromethane	100	0.250
Toluene	200	0.750
Fluorine	0.1	0.0002
Nitrogen tetroxide	5	0.009
Ozone	0.1	0.0002
Uranium (soluble compounds)		0.00005
Uranium (insolubie compounds)		0.00025
Mercury (transfer fluid)		0.0001

[a] *American Conference of Governmental Industrial Hygienists values for 8 hr a day and 5 or 6 days a week exposure.*
[b] *Parts of vapor or gas per million parts of air by volume.*
[c] *Ounces of dust, fumes or mist per 1000 cu ft of air.*

fogging, protect high frequency electronic circuits against stray currents, and minimize bacterial or radioactive transportation.

Sterilization of the cabin could be advisable to prevent germ illness aloft as well as to protect experiments involving a germ free atmosphere. Some bacteria will be present, but in the healthy subject in a closed ecological system, no pathogenic organisms should be present.

Where fuels and oxidants are stored and handled, there will be the need for electronic and chemical sniffers to warn of approaching toxicity through leakage. Table 5 gives threshold values for some oxidant and fuel contaminants. These values are applicable to 8 hr a day and 5 day a week exposures and lower concentrations would be used as limits for warning systems.

Revise Air Distribution Criteria

One of the unique characteristics of air distribution will be the apparently curved path the air will take after discharge to the compartment. This will be caused by the compartment and its contents moving in a curved path as the vehicle rotates. The air, once discharged, will move linearly, just as any massive body.

This effect will appear as a tendency for air distributed radially outward from the center of the vehicle (ceiling outlet) to travel in an arc in counter direction to the rotation of the vehicle. The opposite tendency will appear for air distributed inwardly toward the vehicle axis. This phenomenon will depend on vehicle diameter and rotational speed and can be compensated for by the use of adjustable type of louver distribution.

Air circulation due to thermal convection will be sluggish because of reduced gravity. This must be compensated by high velocity, high induction ratio outlets to prevent any accumulation of respiration products around a crewman. Air will be zoned on the basis of load. Also, a detected compartment decompression will automatically cause full unthrottled oxygen flow for 2 min to cover the evacuation of crewmen.

Short Term Control Loss No Problem

Should power failure or other occurrences result in loss of temperature control without failure of pressurization, there would be no immediate danger. Experiments on humans breathing air at −40 F for an extensive period gave no adverse physiological effects. For about 30 min of light work, while adequately clothed, there is no danger down to −65 F, provided there is protection against nasal frostbite.

On the other hand, a lightly clothed man could stand, for slightly less than a minute, a temperature of 450 F. This would permit compartment evacuation in case of control malfunction in a high load area. Man's capacity to do physical work is about one-third at 100 F of what it is at 75 F and less for mental exertion. Preservation of morale is paramount; there can be few comfort compromises.

Cosmic Radiation Control

The most serious and exacting aspect of environment control, and the one about which there is least unanimity of opinion, is protection against cosmic radiation. Effects of radiation surges due to solar flares is a subject of speculation. Studies of one solar flare in February 1956 showed that 130 roentgens would have been received by a space crew in an 18 hr period. The *roentgen* is usually used to measure radiation dosage and is a measure of the number of ions produced in air at standard temperature and pressure, without regard to ion distribution.

The galaxy itself probably has a magnetic field and acts like a giant cyclotron speeding up charged particles from the sun and other stars. These particles, having energies of the order of 10^9 to 10^{18} volts, could penetrate the satellite and may knock out a human cell, possibly without causing excessive damage.

If massive shielding is used, the primary cosmic particles (hydrogen nuclei and helium nuclei) would be slowed and made more dangerous by the generation of secondary particles which would hit more molecules in the body. Primary particles have tremendous penetrating power; passing through the entire atmosphere of the earth is

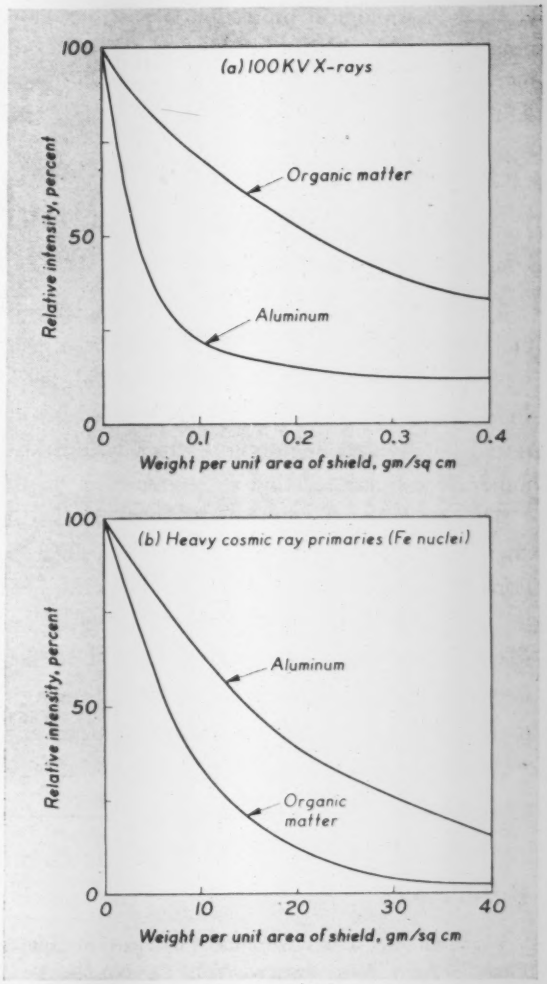
equal to going through 37 in. of lead. Hence mass shielding will not be possible.

Explorers I and III have registered a belt of intense radiation at 600 miles. This belt may be a plasma of dissociated hydrogen atoms (protons and electrons) originating at the sun and held above the earth's atmosphere by the earth's magnetic field. Further data from Pioneer III suggests that the first ring of two primary radiation belts extends from approximately 1400 to 3400 miles altitude above the equator. The second ring extends from about 8000 to 12,000 miles. The time-intensity of this radiation in a given orbit will determine the permissible length of flight time. In an orbit within this belt, it is estimated that radiation inside the vehicle might reach 0.06 to 6.8 roentgens per hr depending on the shielding provided and 100 roentgens with no shielding. At minimum rate, a man would receive in five hours his maximum weekly permissible dose of 0.3 roentgens.

Biologically, the end result of wave and particulate cosmic radiation is ionization which may dissociate molecular constituents within the cell. Velocities of cosmic radiation produce, at each ionization, a rebounding electron which, with the somewhat weakened original ray, constitute secondary radiation capable of further ionization within the crewman's body. Fortunately, while the hits that produce multiple ionization are the most severe of any, they are a small percentage of the total. In addition, their penetration is low and the damage they cause will be confined to the surface of the body.

A rough approximation of net radiation effect can be had by multiplying dosage in roentgens by the *relative biological effects* (RBE) of the radiation concerned, which references radiation potency to that of x-rays. This quantity is known as the *roentgen equivalent man* (REM). It is this quantity that requires clarification through experiment so that compatible shielding can be furnished.

The problem of adequate shielding with present day methods is acute. A reasonable thickness of aluminum (½ to 2 in.) actually increases the health hazard by forming secondary radiation and slowing the faster heavy particles to a speed where they form a cascading disintegration. To be effective, the metal would have to be 3 in. thick. One in. of steel will provide equal shielding.



7 ATTENUATION OF RADIATION is essential to providing the space traveler with a suitable environment. The attenuation of 100 kv x-rays (top) and heavy cosmic ray primaries (bottom) in organic matter and aluminum is shown here. It should be noted that the scales of the horizontal axes differ by a factor of 100 and that the absorptive power of the two materials is reversed for the two types of radiation. A 10 gm per sq cm aluminum "skin" would have a thickness of approximately 1.2 inches

For the other radiative components, the lighter the shielding material, the more effective it is. Assuming the use of the satellite as a fueling station for extra orbital space vehicles, the fuel tank may be the outermost annular area surrounding the cabin cross-section. Fig. 7 shows that an organic liquid is a more effective absorber on an equal weight basis than aluminum, for heavy nuclei. Such an arrangement would be useful also if nuclear power were used. Deflection of charged particles might be accomplished with a strong electromagnetic field generated parallel to the out-

er skin. Physiological protection is possible. Hormones, alcohol and the injection of normal bone marrow will reduce the number of deaths from lethal doses of x-rays. All the dangers of cosmic radiation, and their appropriate counter-measures, will not be known until the radiobiologist has had an opportunity to expose biologic specimens in outer space for extended periods of time.

Some Other Environmental Variables

The foregoing discussion takes no consideration of factors that would be applicable only to a deep space probe involving journeys of several years. In such an application, hibernation may be induced by deep tissue cooling, which would also minimize cellular reaction to cosmic rays.

There will be other personnel considerations in an earth satellite vehicle involving acceleration during takeoff, endurance of very high transient temperatures due to aerodynamic heating of the re-entry vehicle, psychological and social stresses due to risk and confinement, crew selection techniques, sound and vibration, provision for escape, reduced gravity, oculo-agravic illusion (apparent displacement of an object in space due to linear or radial acceleration), and recreation. Study is in progress now on all of these issues.

Other considerations structurally related to temperature control, are the equipment, assembleability, accessibility, precession of rotating machinery, expansion and contraction stresses, and meteorite erosive emissivity change. Many astronautical human factor problems can be solved with the use of existing talents and data. These are being supplemented by studies now in progress so that as little as possible will be left to conjecture when the countdown begins.

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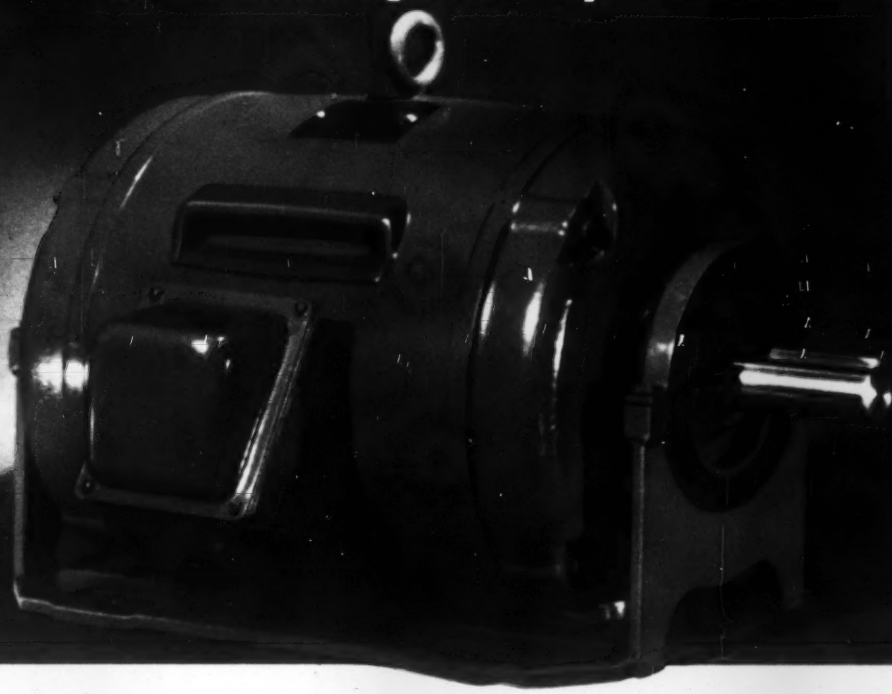

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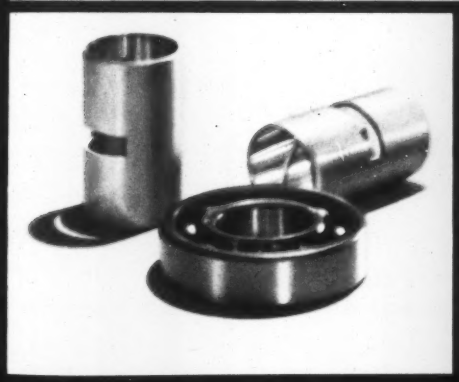

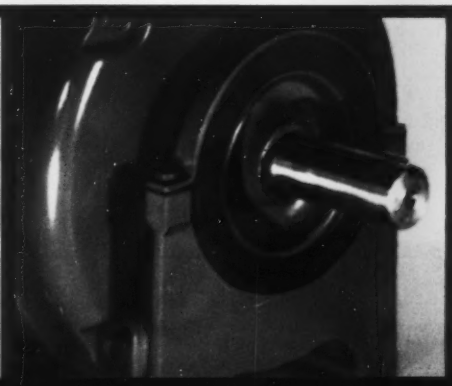

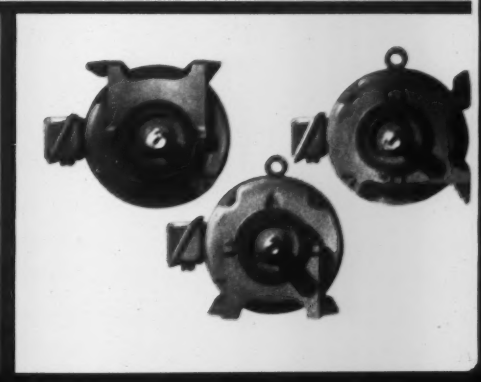

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WAGNER CAPACITOR START MOTORS

PROVIDE DEPENDABLE STARTING . . . GIVE LONG TROUBLEFREE SERVICE . . . OPERATE IN ANY POSITION

Here's the single phase general purpose motor that gives quick troublefree starts every time—thanks to a Wagner-designed quick break switch . . . that has earned the Wagner motor reputation for giving long troublefree service . . . that permits all angle operation in sleeve bearing fhp models.

Wagner Type RK Motors give more horsepower with less bulk—are ruggedly built to permit direct mounting—are small enough to fit in tight spots. Available in a range from ⅛ through 5 horsepower, with either sleeve or ball bearings, with rigid bases or with resilient mountings for exceptionally quiet operation.

You can get these motors from leading motor distributors in your community or through Wagner Sales Offices in 32 principal cities. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-217 gives full details on Capacitor-start Motors.

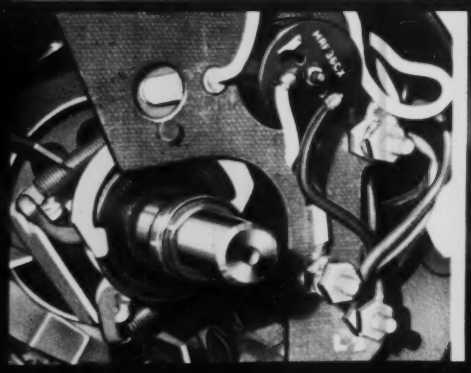
Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 14, MISSOURI

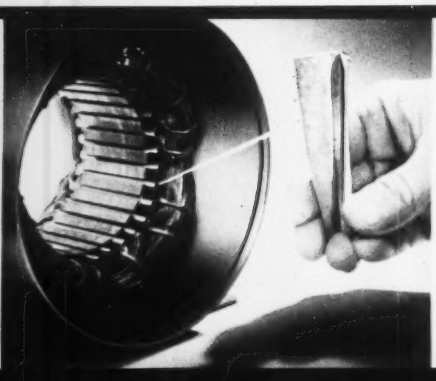
QUICK BREAK SWITCH. The starter is disconnected from the line by this Wagner-designed switch—test proved to make more than a million breaks. (That adds up to two starts per hour for 50 years!)

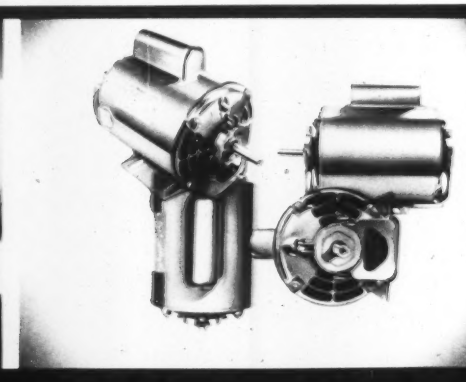
MYLAR* INSULATION. Mylar-paper insulated slot insulation gives excellent protection against moisture, adds thermal stability that gives these motors longer life when unexpected overloads occur.

*DuPont Trademark

ALL-ANGLE OPERATION. The sleeve bearing design, in fractional hp ratings, has a positive lubrication system that permits operation in any position . . . can mean important savings in motor costs to manufacturers.







NEW IMPROVED

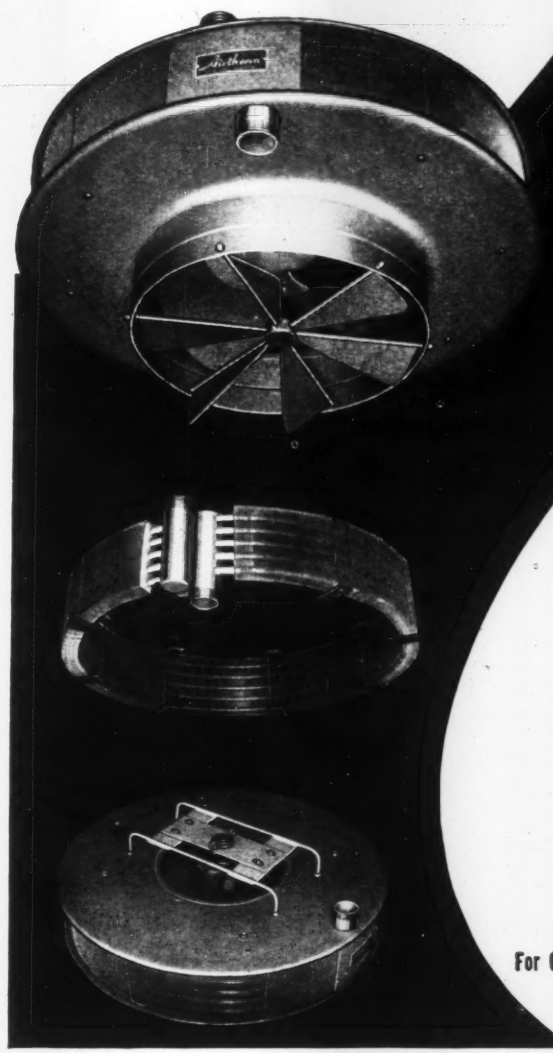
Airtherm

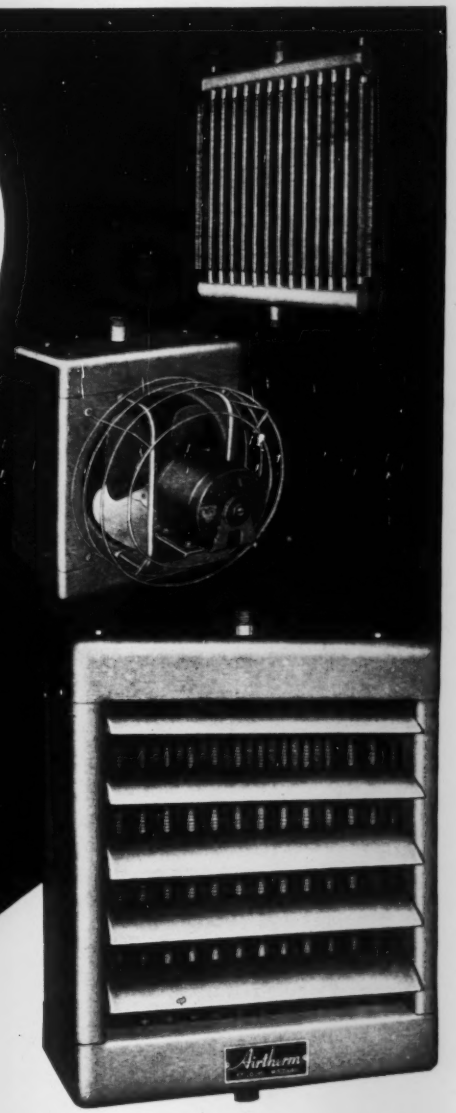
PROPELLER FAN

UNIT HEATERS

FOR STEAM OR HOT WATER

A SIZE FOR EVERY REQUIREMENT



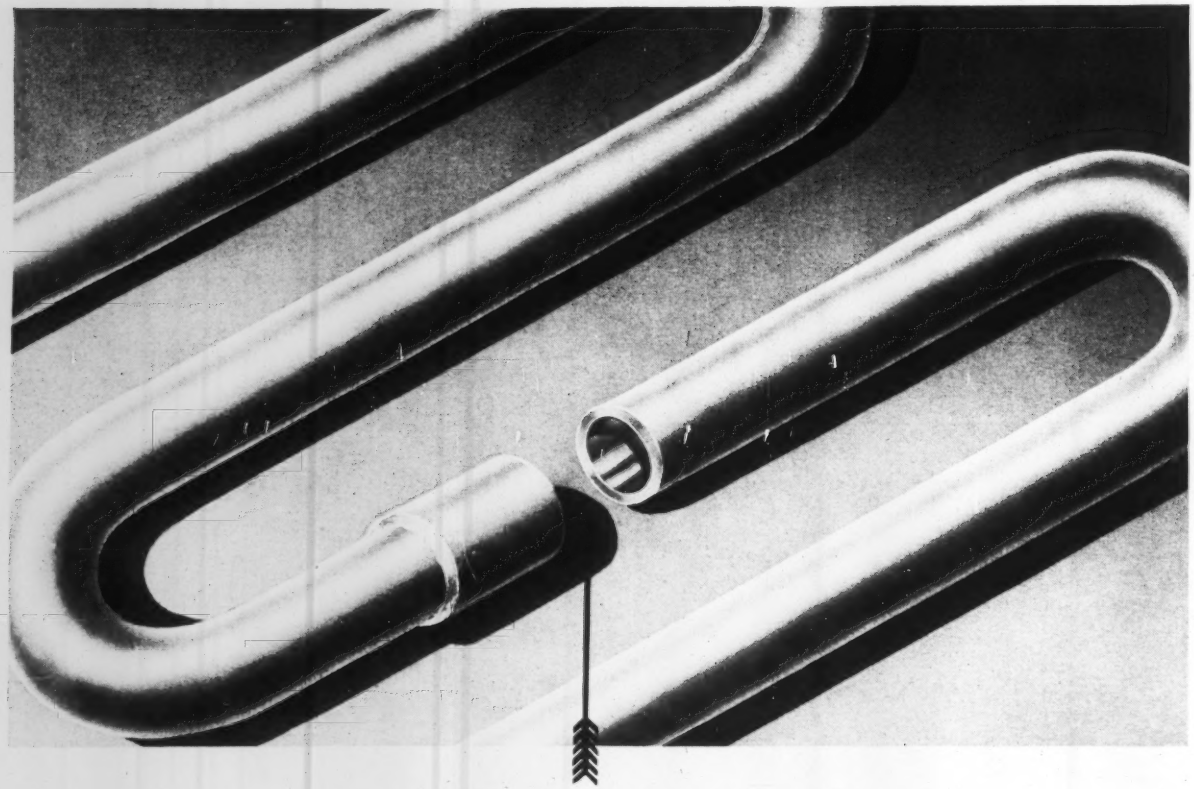


The new Airtherm line incorporates 22 completely redesigned vertical units and 24 improved horizontal units, ranging from 18,000 to 555,000 BTU per hour, with a choice of outlet diffusers to cover practically every air distribution pattern and mounting height. Silent operation is assured by resiliently mounted motors, properly designed fans and casings, and attention to face and outlet velocities. All fans are expertly positioned, balanced and tested. Each unit is tested and rated for performance in strict accordance with the Standard Test Code of the industry. Only brand name, continuous duty motors, especially made for the purpose, are used and mountings are designed for efficient cooling and easy servicing. Rugged coils are formed by hydraulically expanding copper tubing into plate type aluminum fins, each with its own collar, providing increased heat transfer and wide, even spacing to reduce clogging. All coils are tested and tagged for 500 p.s.i. hydrostatic pressure. Casings are phosphatized to insure a long, rust-free life for the attractive baked enamel hammer tone finish.

For Complete Specifications Including a Guide for Selection and Application, Write:

AIRTHERM MANUFACTURING CO.

702 S. SPRING AVE. • ST. LOUIS 10, MO.



The two best ways to join copper tubing:
HANDY & HARMAN
SIL-FOS & SIL-FOS 5

Installers as well as manufacturers of refrigerating, air-conditioning and heating equipment, contractors, designers and consulting engineers—all are finding that "the best thing in the joint" is Handy & Harman's silver brazing alloy SIL-FOS or SIL-FOS 5.

The benefits inherent in these alloys apply to the most complex joints and installations as well as to the simplest. With SIL-FOS, installation speed or production volume depends entirely on your particular needs; a few assemblies an hour to literally hundreds of thousands a day—SIL-FOS adapts readily. Here are what you and *your product* get with SIL-FOS brazing.

STRENGTH—The strength of a properly designed and brazed SIL-FOS joint exceeds that of the metals joined.

LEAKTIGHTNESS—SIL-FOS joints are liquid and gastight, and remain so under severe pressures and the stresses of shock and vibration.

DUCTILITY—SIL-FOS joints have exceptional ductility; enabling them to withstand stresses and strains of vibration, shocks and radical temperature changes fully as well as the metals they join.

CORROSION RESISTANCE—With occasional exceptions, SIL-FOS joints offer strong and lasting resistance to a host of corrosive media.

EASY INSTALLATION—FAST PRODUCTION—With SIL-FOS you can get any production you want—you have a choice of heating methods, jigging setups, inspection techniques, etc.

ECONOMY—Low flow point, fast brazing action, reduced labor costs and vastly reduced reject rate; plus the small amount of alloy needed to make a joint put SIL-FOS in a low-cost catagory unequaled by other methods.

Alloy	Silver Content %	Type	Starts to flow at °F	°C	Free Flowing at °F	°C	
SIL-FOS	15	Wide Melting Range	1185	641	1300	704	For use in joining ONLY nonferrous metals. Used particularly on copper, brass and bronze. Specially effective in joining pipe and tubing and on electrical work.
SIL-FOS 5	5		1195	646	1300	704	

Further details on SIL-FOS and SIL-FOS 5 can be had in the form of Technical Literature from Handy & Harman. **Send for Bulletin 20.** Our research and engineering people are ready and willing to help you with any metals joining problem or plan you may have.

Your NO. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

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5 OUTSTANDING EXCLUSIVE ADVANTAGES IN THE REVOLUTIONARY NEW

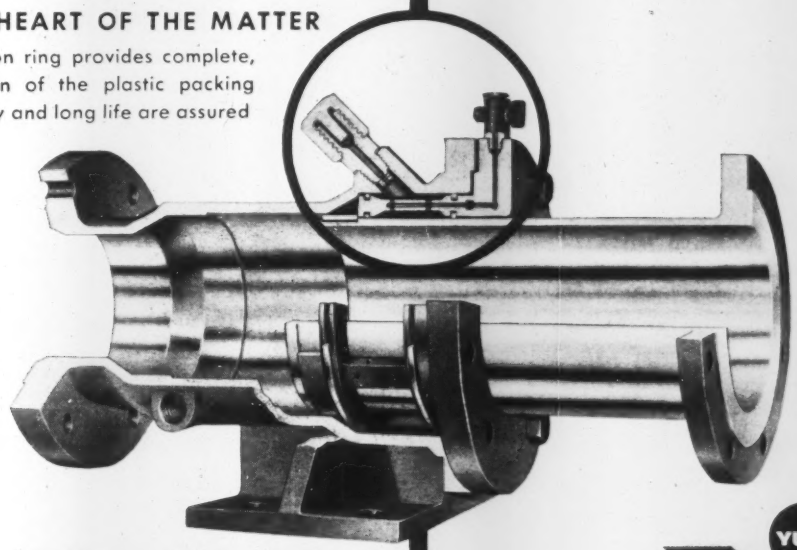
ADSCO RAM-PAK EXPANSION JOINTS

The 5 advantages are: One-point lubrication; 2) *complete* and *uniform* lubrication of the packing assured by the lubricant dispersion ring; 3) removable packing chamber permits replacement of packing without removing expansion joints from the line; 4) rugged outward limit stop is provided by internal guide and, in addition, an outer guide is provided; 5) support base conforms in all respects to A. S. A. standards.

RAM-PAK was designed by ADSCO, the oldest and largest manufacturer of expansion joints in the world. ADSCO invented the first expansion joint in 1877, since then has given the heating industry many great advancements, including the famous Piston-Ring Expansion Joint. Now, in the RAM-PAK, ADSCO offers engineers a high performance, economical, entirely new expansion joint which is unbelievably ingenious in construction. Write for complete information.

HERE'S THE HEART OF THE MATTER

Lubricant dispersion ring provides complete, uniform lubrication of the plastic packing material. Resiliency and long life are assured



ADSCO DIVISION

World's Oldest and Largest Manufacturer of Expansion Joints

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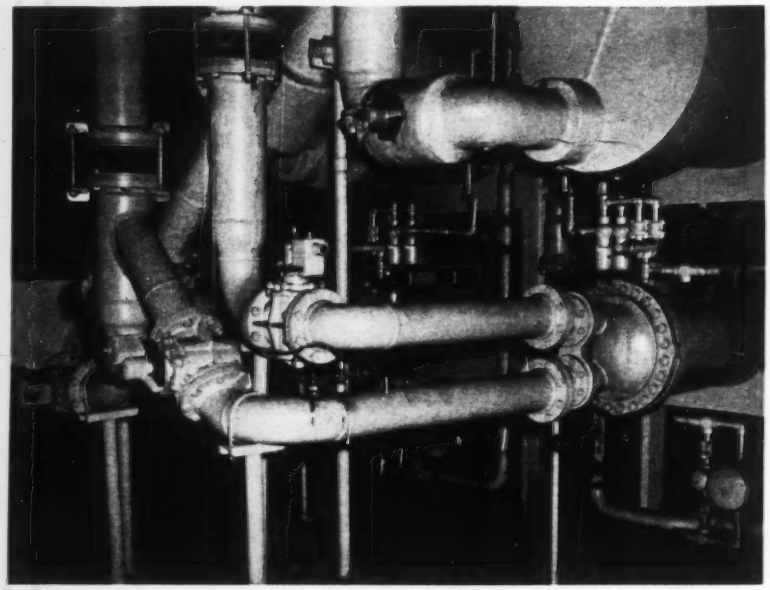
DeZURIK ..the BEST valve for air conditioning because.....



THEY'RE ECONOMICALLY PRICED!

Because of their simple basic design, DeZurik Valves are less expensive than conventional OS&Y air conditioning valves; they're less expensive to buy, less expensive to install, less expensive to maintain.

They'll save money other ways, too! One DeZurik Balancing Valve can take the place of two other valves; used for throttling AND shut-off, it eliminates the cost of an extra valve. And DeZurik Balancing Valves are furnished tapped on the downstream side of the valve to accept a pressure gage for balancing. This costs much less than tapping the pipe.

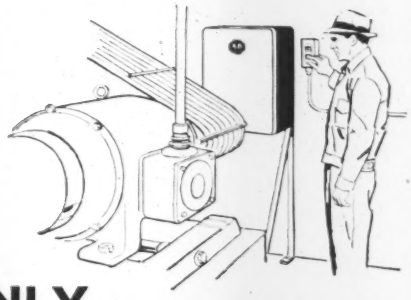
The DeZurik Valves shown above are installed on chilled water and condenser lines at Stewart's Department Store, Baltimore. The system was designed by Henry Adams, Inc., and installed by George A. Peters Co., both of Baltimore.

Available in sizes ½" thru 20", in 2-way, 3-way or 4-way models with manual, on-off, or positioning actuators. For more details, see the DeZurik representative in your area, or write for a complete list of installations.

DeZURIK CORPORATION
SARTELL, MINNESOTA

Only DeZurik Valves give you all these advantages:

1. Easy Operation
2. Drip Tight Shut-off
3. Low Pressure Drop
4. Best for Balancing
5. Low Installation Cost
6. No Maintenance
7. Proved Record of Dependability
8. Compact Size
9. Economically Priced
10. Versatility beyond compare

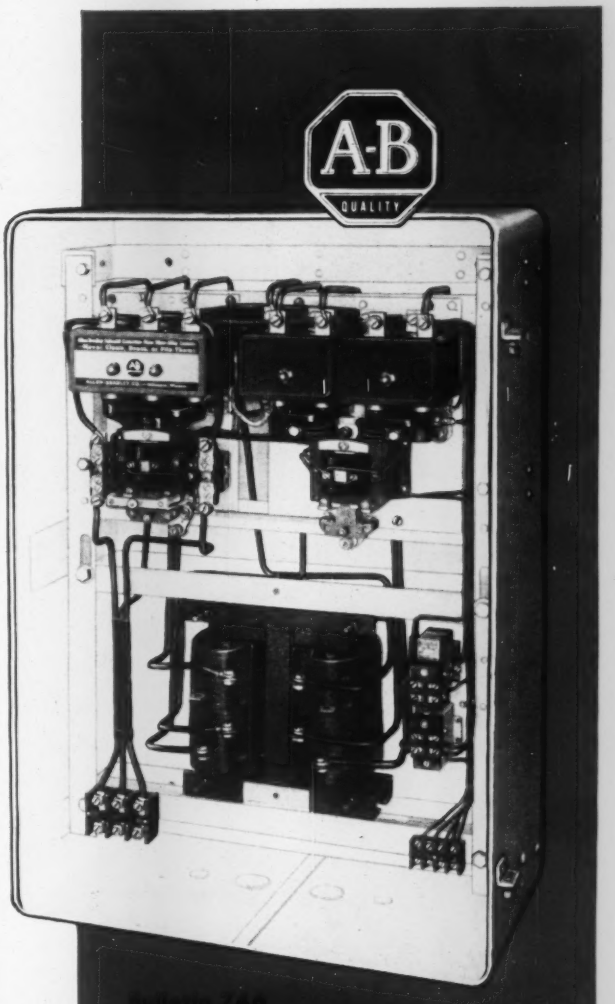


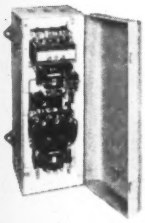
ONLY ALLEN-BRADLEY CAN PROVIDE ALL THE ANSWERS

—for reduced voltage starting of heavily loaded compressor motors

The broad line of Allen-Bradley reduced voltage starters makes possible a selection of the best starter for any air conditioning system—not only to meet the power company's requirements but also to provide the best starting conditions for the motor and the compressor.

The simple solenoid contactors in A-B reduced voltage starters have only ONE moving part—assuring millions of trouble free operations. And their double break, silver alloy contacts never need costly maintenance. Accurate, reliable overload relays protect motors against burnouts. Write for Publication 6088.



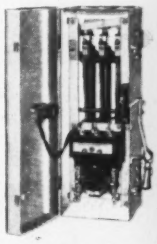


Bulletin 740

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting, and they are automatically cut out after a predetermined time. Turning a single screw on the starter frame adjusts the compression resistors exactly to motor and load conditions for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

Bulletin 640

Where remote control is not needed, these graphite compression disc resistor starters provide stepless acceleration of squirrel cage motors. Operated by hand lever, the smooth starting of the motor is under the control of the operator. No-voltage and dependable overload protection is provided. Ratings to 200 hp, 220-440-550 v.



Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

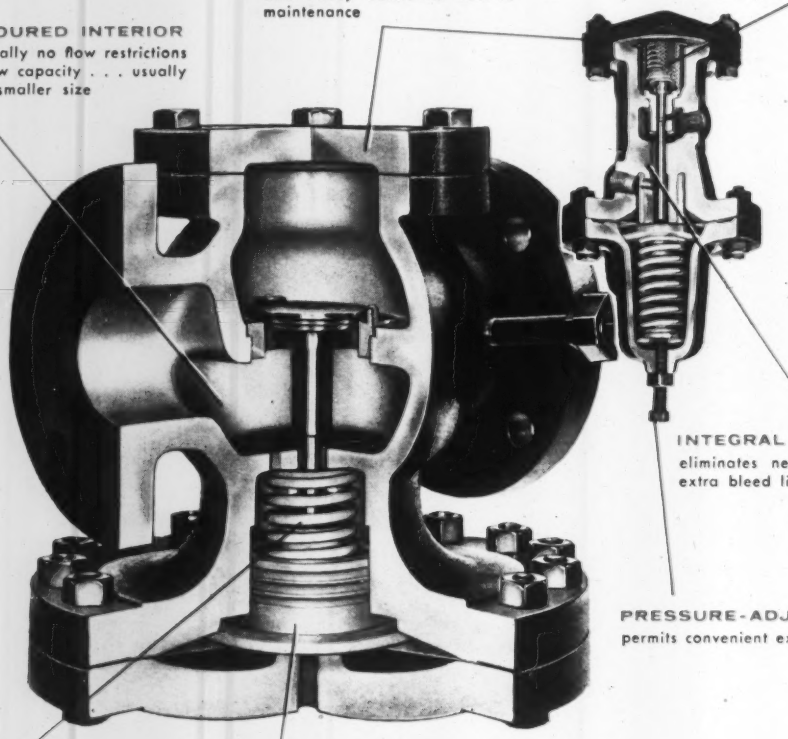
NEW... from K&M

EXTERNAL PILOT-OPERATED PRESSURE REGULATOR

fast-acting, accurate . . . tight shut-off even on dead-end service

Examine it yourself . . . feature for feature. K&M has made a vast improvement in external pilot-operated pressure regulators.

It simplifies installations: *requires one less pipe line.* It offers lowest maintenance: *the result of good hydraulic and mechanical design throughout.* It gives excellent performance: *try one and compare with any other regulator of its type.*



BUILT-IN STRAINER
protects pilot from scale, dirt, other foreign matter, is removable for cleaning

BLIND FLANGES
on both main valve and pilot allow easy access for routine maintenance

CLEANLY CONTOURED INTERIOR
has no spider, practically no flow restrictions . . . gives greater flow capacity . . . usually permits economy of smaller size

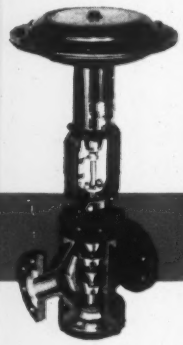
INTEGRAL BLEED ORIFICE
eliminates need for installation of extra bleed line

PRESSURE-ADJUSTING SCREW
permits convenient external pressure setting

GUIDE PISTON
has balancing grooves which hydraulically center guide, prevent binding and side-thrust

CONTROL SPRING
is isolated from main flow stream for greatest protection

If you would like a more detailed, close-up look at K & M's new Type 471 External Pilot Pressure Regulator, send for Bulletin 471A.



K&M
diaphragm control valves
Our 79th Year

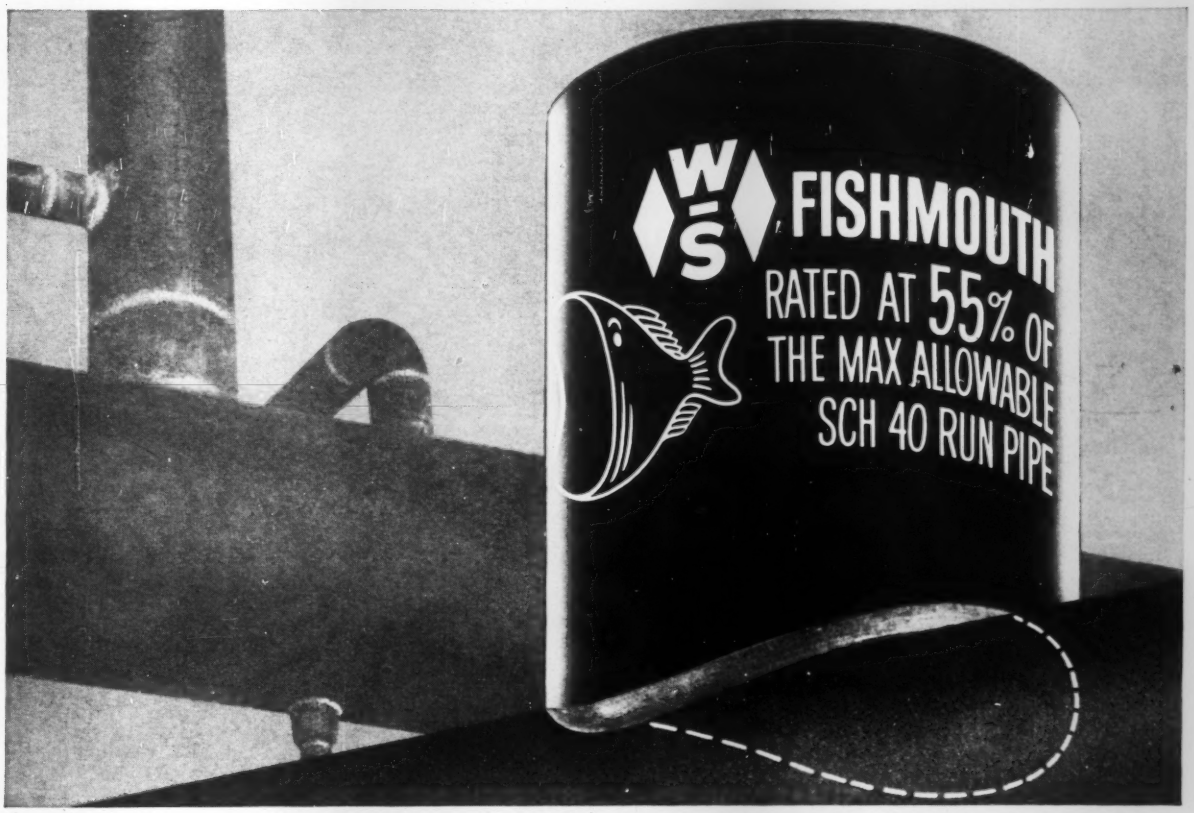
KIELEY & MUELLER, INCORPORATED
Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

S.A. 1808

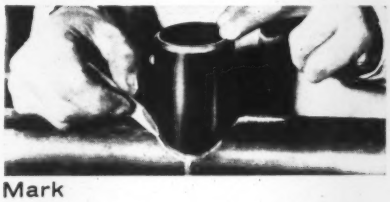
FOR BRANCH CONNECTIONS 2 INCHES OR OVER:

Now! Only 81¢ for a 2″ branch fitting!

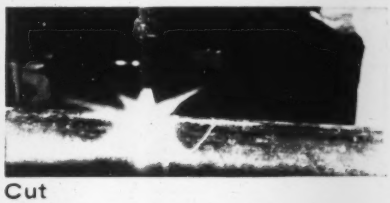
THAT'S ALL A NEW, READY-MADE W-S FISHMOUTH COSTS



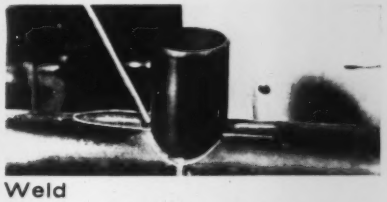
IT'S THE MOST PRACTICAL WAY TO MAKE A BRANCH CONNECTION



Mark



Cut



Weld

The W-S FISHMOUTH saves 50 per cent or more over commercially available branch fittings . . . *costs even less than your own field- or shop-made connection.* Made from Schedule 40 pipe, W-S FISHMOUTH is fully machined and perfectly shaped for strong, leak-proof joints. A ready-made W-S FISHMOUTH is rated for working pressures to 55 per cent of maximum run-pipe limits. Sizes: 2″ to 12″ IPS, butt weld ends. Fewer sizes handle many more jobs, eliminate need for special fittings.

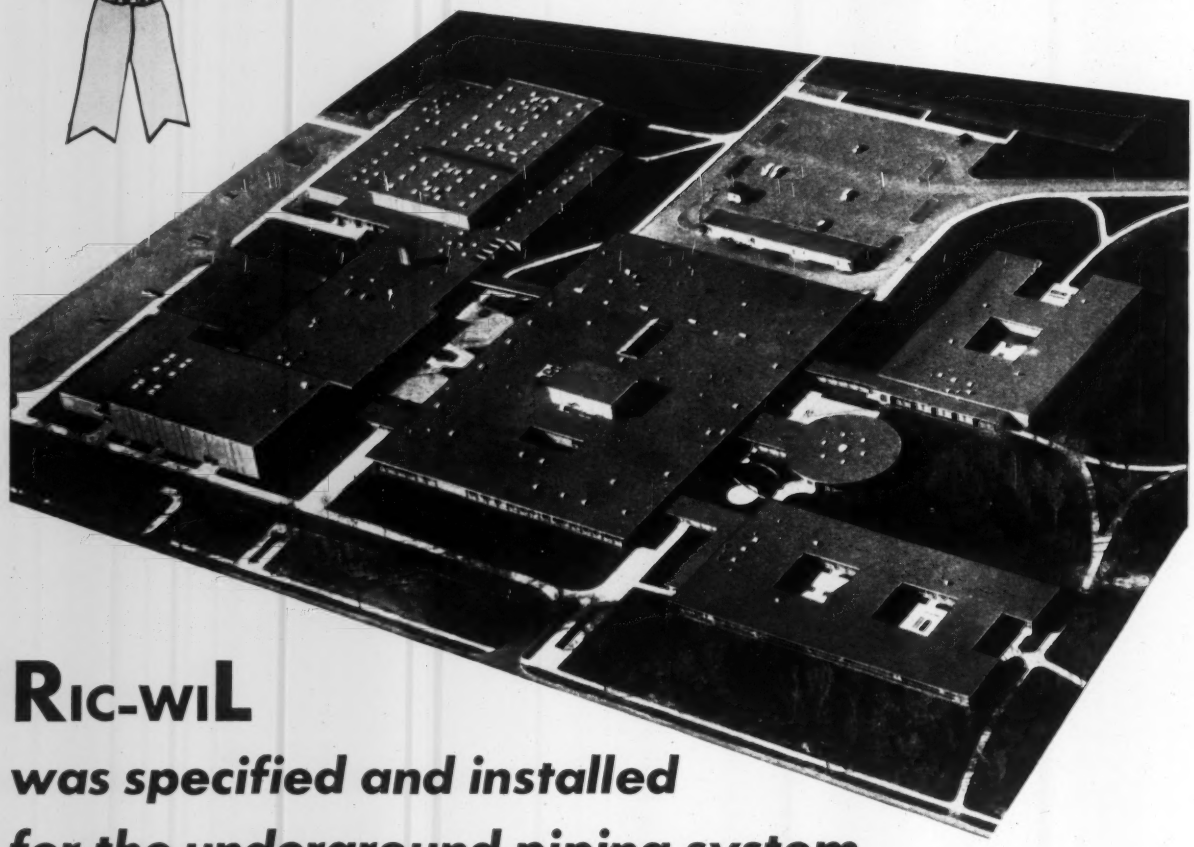
No time or cost required to shape, fit or bevel. Ideal for close-quarter work. Easy access to inspect weld penetration or to back-weld. W-S factory machining means a secure, permanent installation every time.

Ready-made, the W-S FISHMOUTH costs less to buy and install than anything you can buy or make. Write, today, for complete information, prices and names of distributors to: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

FORGE AND FITTINGS DIVISION **PORTER** ***H.K. PORTER COMPANY, INC.***

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD

at Award Winning Linton High School...



RIC-WIL
was specified and installed for the underground piping system

Architects: Perkins and Will; Ryder & Link
Consulting Engineer: E. R. Gritschke
Contractor: Tougher Plumbing & Heating Co.

RIC-WIL is indeed proud to be a part of the Linton High School Project. All of the firms participating in the annual awards are to be congratulated and encouraged in promoting better design of educational buildings. For over 49 years RIC-WIL has supplied the distribution piping systems for educational buildings through the United States, Canada and many foreign countries. These piping systems have proved to be the finest in Thermal efficiency and mechanical strength. Complete information is available on the many types of systems. Write, wire or phone for literature.

*School Executive and Educational Business Magazines annual award for Architectural and Engineering excellence. Linton High School, Schenectady, New York.

See our catalog in Sweets

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency
SINCE 1910

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

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IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

This $5,000,000 fire might have been prevented with a **steel pipe** automatic sprinkler system

There wasn't much left when this $5,000,000 industrial property in New England burned to the ground. Yet how different the ending could have been if a *steel pipe* fire sprinkler system had been installed and the fire checked at its inception.

Yes, it pays to have an automatic sprinkler system in any building—store or warehouse, hospital or hotel, theater or school. As to cost—insurance premium savings often more than pay for the fire protection system's installation.

Backbone, of course, of fire sprinkler systems is dependable *steel pipe*. Architects, engineers and contractors know that low-cost, easily-worked *steel pipe* provides lasting and dependable service. That's why *steel pipe is first choice* for fire sprinkler systems, electrical conduit, vent and drainage lines, structural applications, radiant heating, snow melting, refrigeration, ice making and gas, air and water transmission lines.

Automatic sprinkler systems check fires at their start—quickly, automatically and economically.

STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

INSIST ON PIPE MADE IN U. S. A.

COMMITTEE ON STEEL PIPE RESEARCH

American Iron and Steel Institute

150 East Forty-Second Street, New York 17, N.Y.

Now Gives MORE "UMPH" and "POWER" To That ALREADY GREAT—POWERFUL No. 1000 U.S. SUPER BASE DIFFUSER.

GREATER FREE AREA IS NOW FURNISHED in the GREATEST-of-ALL PERIMETER INTAKES The No. 2000 U.S. PERIMETER BASE INTAKE

Increased Capacity—Efficiency—Beauty and Economy.

FROM the MOST MODERN and FINEST REGISTER and GRILLE FACILITY

No. 1000 U.S. NEW SUPER-BASE DIFFUSERS Afford a beautiful Sense of Security and SATISFACTION. No PERFORMANCE WORRIES.

NEWS EXTRA! New No. 1048 U.S. SUPER BASE DIFFUSER has Another Row of Oblong Openings. Now--Capacity for 6", 7", or 8" Round Supply Pipes

Made in No. 1024 (2 foot Sections) No. 1048 (4 foot Sections) Longer Lengths or Runs can be made Using Multiple Sections set end to end with Connectors.

ANOTHER NEWS EXTRA! New No. 1024 has Another Row of Oblong Openings to Boost Supply Power. Now adaptable to use of 4", 4½", 5" and even 6" Round Supply Pipes

The No. 2000 U.S. PERIMETER BASE INTAKES Match No. 1000 Series.

New No. 2048 U.S. PERIMETER BASE INTAKES--4 foot length GREATER FREE AREA

New No. 2024 U.S. PERIMETER BASE INTAKE--- 2 foot length

No. 2000 U.S. NEW PERIMETER BASE INTAKES ELIMINATE RETURN AIR PROBLEMS and GUARANTEE UNIFORMITY and MATCHING APPEARANCE of No. 1000 DIFFUSERS and No. 2000 INTAKES.

Do Not Take Substitutes — Get the BEST — U.S. No. 1000's NEW LARGER CAPACITY No. 1000 BASE DIFFUSERS are IDEAL for COMMERCIAL SYSTEMS.

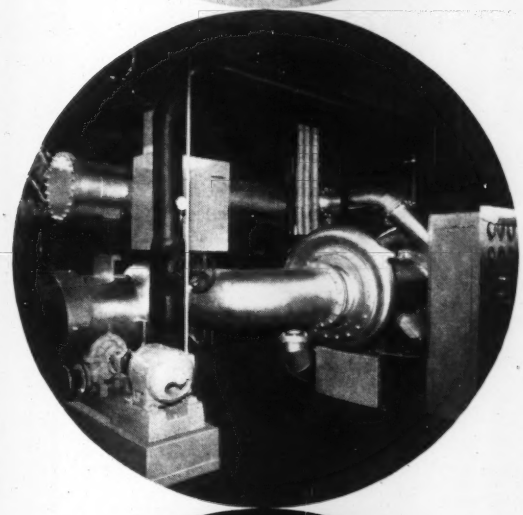
INDOOR COMFORT

NRAW

UNITED STATES REGISTER COMPANY

BATTLE CREEK, MICHIGAN

MINNEAPOLIS • KANSAS CITY • ALBANY



New annex to Indiana National Bank, Indianapolis (Top Illustration) *Architect:* D. A. Bohlen & Son. *Consulting Engineer:* Bevington, Taggert and Fowler. *Mechanical Contractor:* R. M. Cotton Company.

Climate by Chrysler

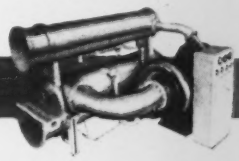
. . . cuts the cost of cooling two buildings for Indiana National Bank

The new 9-story addition to Indiana National Bank in Indianapolis is adjacent to an older 9-story bank annex which was already air conditioned. When the consulting engineers planned the cooling system for the new building, they came up with a unique way to cool *both* buildings with a Chrysler Centrifugal Liquid Chiller in the new addition as the basic unit . . . and bring the bank considerable savings in operating costs.

The new 218-ton Chrysler Chiller was also connected to the air handling equipment in the old annex. Thus, the new, extra-efficient unit operates under most economical conditions whenever air conditioning is needed in either building. The two units in the old annex are used only when additional capacity is simultaneously needed for both buildings.

What gives the Chrysler Centrifugal Chiller its extra efficiency? The exclusive true volute casing design is the answer. It delivers more tons of air conditioning per motor horsepower. (Or, if you wish, you can get a given tonnage with a smaller, less expensive motor—and save money on initial cost and operating expense.)

No matter how large or complicated the air conditioning job, Climate by Chrysler can be custom-engineered to your exact requirements. For complete information, or technical assistance, contact your local Chrysler Applied Machinery and Systems sales office.



CHRYSLER
AIRTEMP

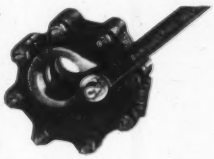
Airtemp Division, Chrysler Corporation, Dept. Y-109, Dayton 1, Ohio
In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario

When you need...

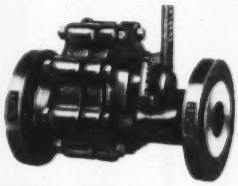
- Quick action
- Leak-Proof Seal
- Minimum Pressure Drop
- Straight-through full flow
- Valves that cannot wedge or jam
- Self-grinding rotating disc

Specify Everlasting Valves

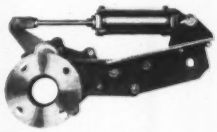
For more information **WRITE** for these bulletins.



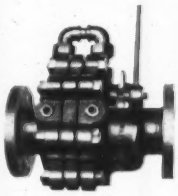
BOILER BLOW-OFF
Quick acting, also handwheel operated "Y" and angle types. For pressures up to 600 psi.



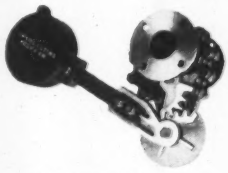
GENERAL SERVICE
Where drop-tight seal and full flow is essential.



CYLINDER OPERATED
Can be remotely controlled, electrically or manually.



STEAM JACKETED
Assures free flow of viscous materials.



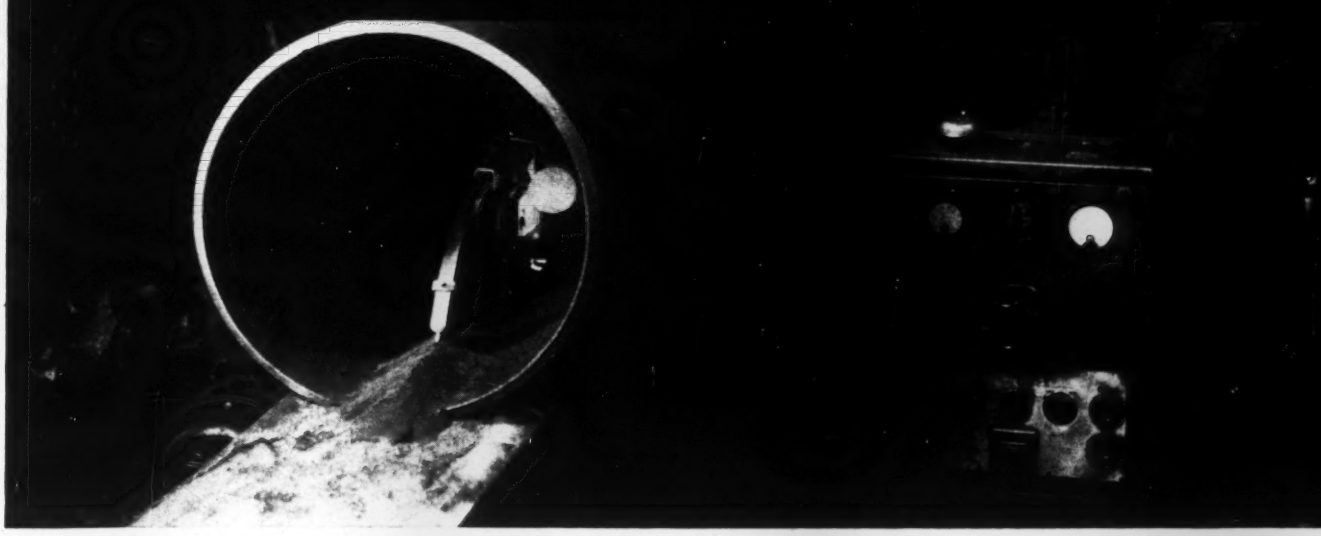
WEIGHT-OPERATED
For automatic drains or emergency shut off.

Everlasting VALVES

EVERLASTING VALVE CO., 61 FISK STREET, JERSEY CITY 5, N. J.

EV 408

SELF-FLUXING ACTION OF 4-D WROUGHT IRON CONTRIBUTES TO SOUND, DURABLE WELDS



For superior 4-D Wrought Iron welding results, reduce your welding speed slightly below that used for steel. In electric welding, also reduce the current slightly. With oxy-acetylene welding, a neutral flame is best.

Two-Component Material—4-D Wrought Iron consists of two distinctly different components: high purity iron base metal and glasslike iron silicate. The fluxing action of the silicate protects the base metal during heating. This enables welders to easily produce sound, durable welds.

Melting Characteristics—Each of 4-D Wrought Iron's two components has its own fusion temperature. The siliceous material melts first (2100°-2200°F), several hundred degrees before the iron (2730°F). But don't confuse the fluxing of the iron silicate with melting of the actual base metal. Just continue heating until the iron fuses.

Welding Processes—4-D Wrought Iron Pipe may be easily joined through a number of commonly used welding processes: forge welding, electric resistance welding, oxy-acetylene welding, electric metallic arc, electric carbon arc and submerged arc welding, and bronze welding.

Welding Procedures—Weld slowly enough to allow the siliceous material to float out of the weld. Avoid unnecessary rubbing or agitation of the molten metal. It causes formation of oxides which may be trapped.

Fittings Available—4-D Wrought Iron welding fittings for pipe are available in a complete range of sizes, including bends, Van Stone welding stubs, reducing nipples, tees, crosses, and caps. Fabricators in many cities produce 4-D Wrought Iron welding fittings.

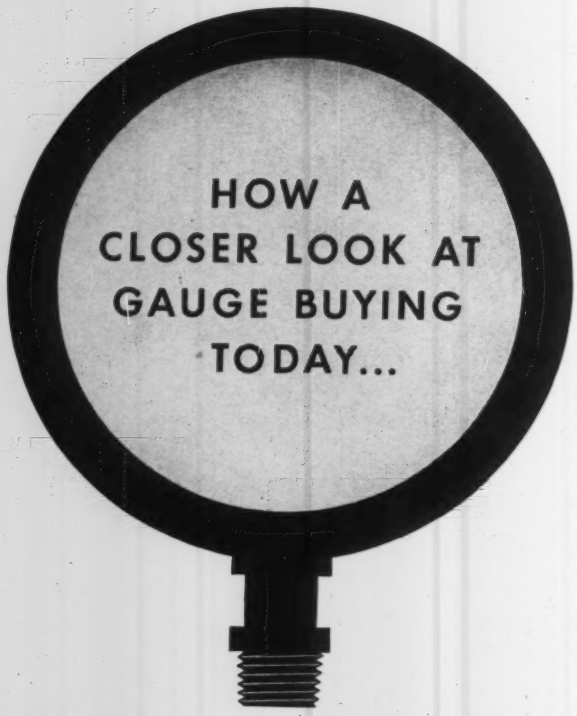
Bonney Forge and Tool Works, Allentown, Pa.; Heat and Power Corp., Baltimore, Md.; Ladish Company, Cudahy, Wis.; Midwest Piping and Supply Company, St. Louis, Mo.; Taylor Forge and Pipe Works, Chicago, Ill.; and Tube Turns, Inc., Louisville, Ky., manufacture extensive lines of 4-D Wrought Iron welding fittings.

Write for comprehensive welding booklet: A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

BYERS 4-D WROUGHT IRON

TUBULAR AND FLAT ROLLED PRODUCTS
ALSO AMBALLOY ELECTRIC FURNACE STEELS
AND PVC PIPE, SHEET AND ROD STOCK

Corrosion costs you more than Wrought Iron



can save up to 40% on many pressure gauge applications

Analyzed your gauge needs lately—how much gauge performance you're getting, compared to what you need and what you pay for? Perhaps it's time for a closer look at United States Gauge with its line of 50,000 standard pressure gauges, plus specials (and all possible choices in case styles, sizes, materials and pressure ranges). For example, note how you can save up to 40% on premium gauges and still get premium performance with the USG A-Line *(top, right)*. Note, too, how you can get the exact gauge for *any* need and cut waste of under-buying or "over-gauging" . . . from all the gauge lines available at this one source. Then check the USG distributor listed in your Yellow Pages. Or write direct for catalogs and name of your nearest distributor today.

UNITED STATES GAUGE
Division of American Machine & Metals, Inc., Sellersville, Pa.

Find Your Nearest Distributor in the "Yellow Pages"

Paying needless premium prices for reliability? USG A-Line pressure gauges have premium construction, save up to 40% on premium prices. Meet A.S.A. Grade A standards, including 1% accuracy. Extra rugged, they are built to *deliver* longer under severe operating conditions, where you do not require the accuracy of Grade AA gauges, but where reliability and cost-cutting are "musts". Wide choice of Bourdon tubes, case styles and sizes, pressure ranges, and movements. You must see the sturdy design and price to believe the value and performance. Models for general-purpose service, altitude, refrigeration, ammonia and hydraulic applications. *Write for Catalog 305.*

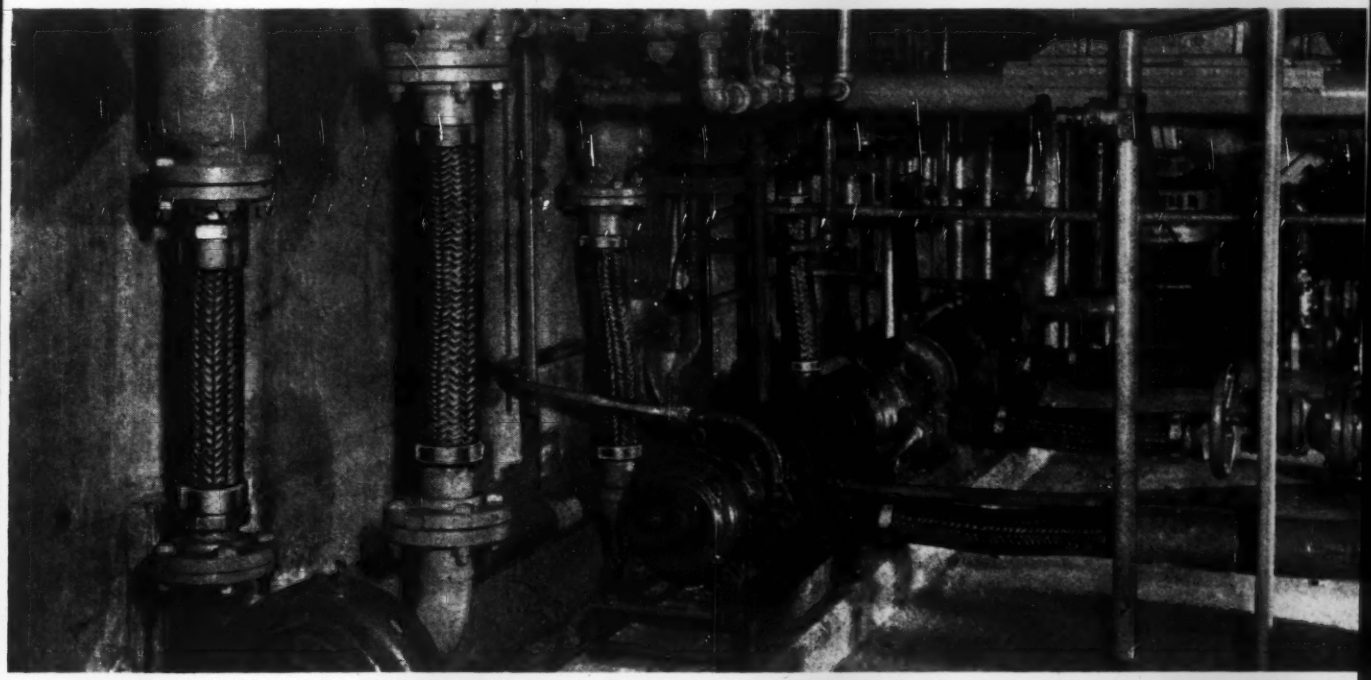
Buying too much gauge for your purpose? Save with volume-priced, precision-built USG Drawn Case Gauges for service where your gauge need calls for A.S.A. Grade B standards, including 2% accuracy. *Write for Catalog 64A.*

Getting all the accuracy you're paying for? You can't buy more precision than with USG Test Gauges which meet or exceed A.S.A. Grade AA standards, including accuracy as high as 0.2 of 1%. *Write for Catalog 400.*

40—2

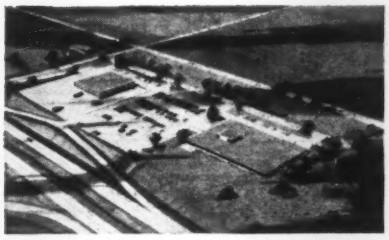
APPLICATION HINTS:

Ways to simplify construction and cut costs with Flexpipe



Six Flexpipe connectors, 2½" I.D., 24" long, at the three boiler feed pumps. In the foreground are the Flexpipe connectors at the hot water pump feeding Weathermaster units throughout the Administration Building of the Illinois State Toll Highway Commission.

Flexpipes made this heating and cooling system more compact, cut installation time



Artist's rendering of the Administration Building, Illinois Toll Highway Commission. Lankton, Ziegele, Terry & Associates: Architects and Construction Engineers.

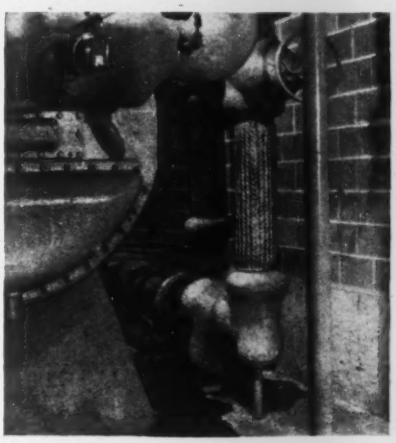
Heating and cooling systems can utilize all the advantages offered by Flexpipe connectors. Flexpipes take up movement caused by expansion and contraction in piping from wide variations in temperature. At the same time, they absorb vibration and dampen noise from pumps.

They make possible better utilization of space because they are easier to install in tight quarters and can handle offset. Note in photo above how vertical Flexpipes from boiler feed pumps saved space by making possible easy connections to piping flush against wall. Conventional piping would require considerably more work room—plus the time and cost of installing elbows, couplings, short runs of pipe, etc.

Flexpipe's flexible core can be either bronze, galvanized steel or stainless steel—I.D.'s range from ¼" through 16".

WHERE TO BUY: Leading wholesaler distributors can provide you with information about Flexpipe in standard sizes. For the name and address of the distributor serving your area, or for more detailed information, write to: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

59155



Two 8" I.D. Flexpipe connectors handle cooling water for refrigeration unit.

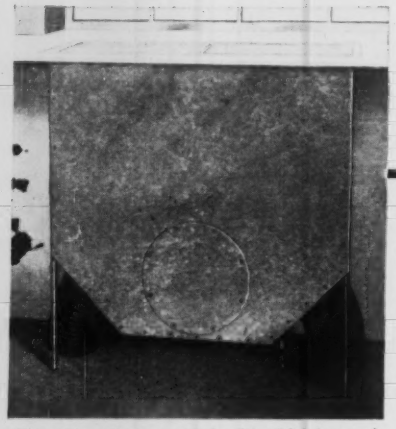
Flexpipe®

an

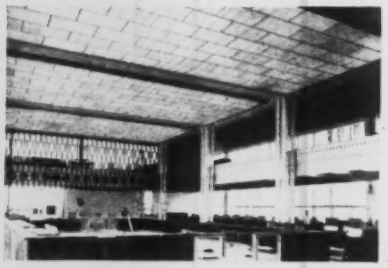
ANACONDA®

product

at the new National Bank of Detroit main office . . .



The under-window model, with 45° inlets and top discharge air delivery, produces the same draftless air flow pattern characteristic of all Kno-Draft equipment. The air moves upward along the window and out under the ceiling, effectively conditioning an area approximately 25 feet from the outside wall. Helical spring hot and cold air dampers in each unit ensure proper air mixing . . . and full heating and cooling is achieved because dampers close with less than 2% leakage.



On the main banking floor a grid of aluminum, gold anodized, hexagonal cell lighting diffusers hangs approximately 20" below the ceiling proper, hiding ceiling-mounted lighting channels. Ducts running through a piping space above the ceiling introduce air through Kno-Draft adjustable ceiling air diffusers, all of which enable easy adjustment of air pattern.

KNO-DRAFT air diffusers and high velocity valve attenuators provide constant comfort conditions

At the beautiful new headquarters of National Bank of Detroit, the combination of precisely engineered Kno-Draft dual duct high velocity valve attenuators and adjustable air diffusers provides a 500,000 sq. ft. interior with constant comfort.

The dual hot and cold high velocity air distribution system includes nearly 300 overhead and more than 700 under-window attenuators. These units accurately mix, proportion, and diffuse the air to the building's various rooms at precisely the desired volume and temperature. Kno-Draft attenuating and air diffusion equipment was selected because it responds most rapidly to changing loads . . . most suitably serves the wide variety of comfort demands of occupants in private offices . . . and sharply reduces operational costs.

The Connor Engineering Corporation is justly proud that Kno-Draft equipment was chosen for this leading Detroit building—an endorsement of Connor experience and performance. Numerous Kno-Draft dual duct diffusion models are available. One of these is engineered for your next building.

Request Bulletin K-33-A for complete information.

CONNOR... for Constant Comfort Conditions

CONNOR ENGINEERING CORPORATION

DANBURY • CONNECTICUT

CONNOR ENGINEERING CORPORATION

kno·draft®

high velocity air diffusers

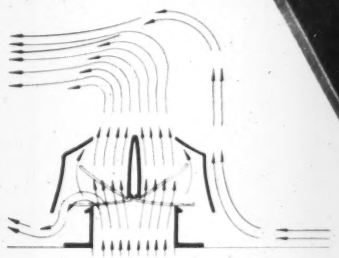
NOW 25% ADDED

RESERVE EXTRACTION CAPACITY

for abnormal conditions!

2 NEW IMPROVEMENTS MAKE "THE BEST" EVEN BETTER!

"O/SR" Ventilator with flaps in normal position.



CONTINUOUS POSITIVE EXTRACTION
in any weather—without rotation or running costs.

1. AIR-FOIL FLAPS — designed with aid of wind tunnel, new hinged flaps reduce drag and increase extraction lifting effect.

2. ADJUSTABLE CENTER — 3 positions: Wide open for extra hot days, partially open for rainy days, fully closed for cold days.

RECENT INSTALLATIONS—General Controls Inc., Glendale; Rexall Drug Store, Ventura; Almond Growers Exchange, Sacramento; American Electronics Co., El Monte; Hammond Furniture & Fixture, Los Angeles; W. J. Sloane Co., San Francisco; Continental Airlines, Inc., Los Angeles; Harvey Aluminum Co., Torrance; North American Aviation Co., El Segundo.

COLT®

SYSTEM OF NATURAL VENTILATION

Already tested and proved throughout the world, COLT'S "SR" heavy duty ventilators now gain a full 25% extra capacity through addition of adjustable center. Air-foil flaps actually add to air flow velocity when entirely open, yet may be set for rainproof efficiency or entirely closed to keep heat in.

Your client saves money when he installs a COLT system in his plant because there are no running or maintenance costs: he makes money with the increased production resulting from improved employee comfort and morale. More than 45,000 installations in every climate on earth prove COLT'S economy and dependability.

COLT VENTILATION OF AMERICA, INC. 4652 Hollywood Boulevard, Los Angeles 27, California
Phone: NOrmandy 2-1181

MAIL THIS COUPON TODAY

Please send, without obligation, items checked:

☐ Newly revised TECHNICAL BROCHURE of the Colt System.

☐ "Some Aspects of Fire Prevention in Industrial Buildings", by M. J. Reaney.

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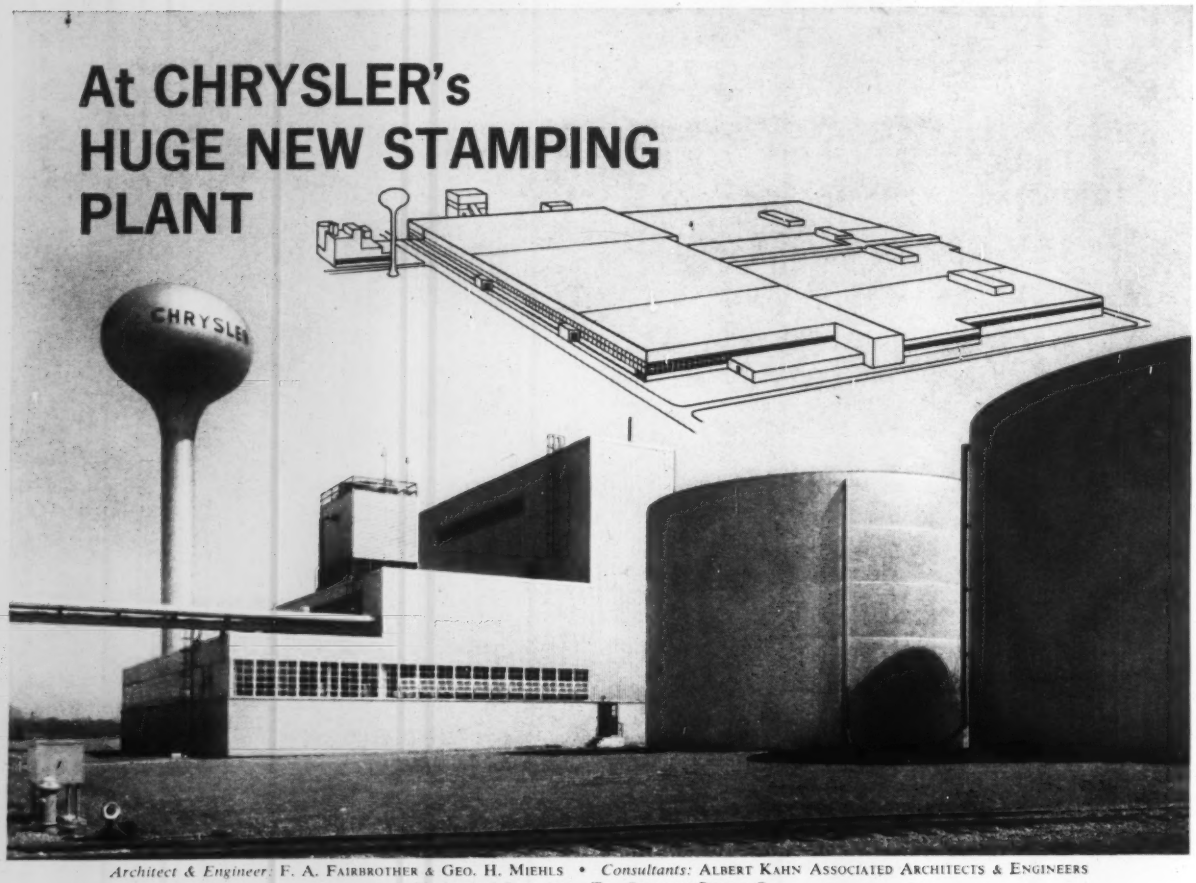
Distributors in Northern and Southern California, Kansas and Missouri

At CHRYSLER's HUGE NEW STAMPING PLANT



Architect & Engineer: F. A. Fairbrother & Geo. H. Miehls • *Consultants:* Albert Kahn Associated Architects & Engineers
Mechanical Contractor: The Stanley Carter Co.

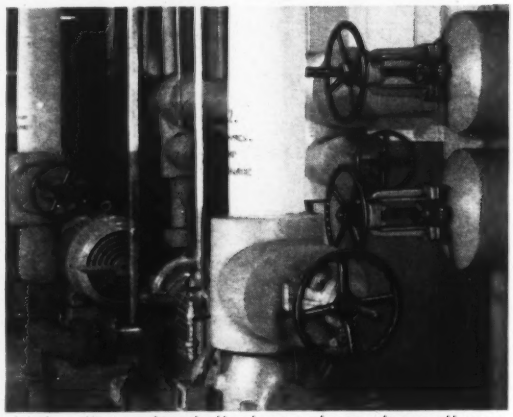
JENKINS VALVES assure reliable, economical control of Production's Lifelines

Cited as one of the nation's "Top Ten Plants of the Year", Chrysler Corporation's stamping plant at Twinsburg, Ohio, is a 34-acre model of building and manufacturing efficiency.

Go into the power plant and you will find Jenkins Valves everywhere, controlling "production's lifelines" that supply 150,000 pounds of steam per hour . . . 30 million cubic feet of air per day . . . 7500 gallons of cooling water per minute. Jenkins Valves got the job because "every effort was made to install the finest mechanical and electrical equipment . . . and to insure minimum costs by eliminating excessive upkeep and equipment with a short life span".

It is a highly significant fact that all building experts and operating engineers agree *"there's nothing better than Jenkins Valves"*. Many will always insist on JENKINS for critical services, and will prefer them for general use. After all, Jenkins Valves cost no more!

When you are buying or specifying valves, remember that the best valves are the best assurance of economical service. Jenkins Bros., 100 Park Ave., New York 17.



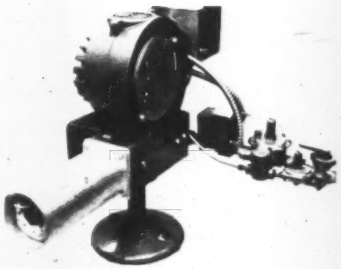
In the ultra-modern boiler house shown above, all general service valves controlling pipelines are JENKINS

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864
Jenkins Bros

Sold Through Leading Distributors Everywhere

EQUIPMENT DEVELOPMENTS . . .

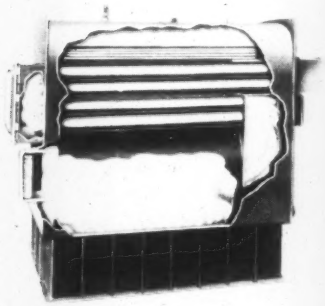
For reviews of Recent Trade Literature see page 218



Gas Burner . . .

. . . packaged, completely piped and wired—*Bryant Industrial Products Corp.*, 17700 *Miles Ave., Cleveland* 28, *O.*

Offers three control options: manual, semi-automatic, full automatic; available in two capacity ranges, each providing minimum of 50,000 and maximum of 450,000 or 600,000 Btu per hr; for use with all types of commercial fuel gases, including liquified petroleum; all units have pilot and pressure regulators.



Three-Pass Boiler . . .

. . . for steam and hot water heating in large buildings—*Portmar Boiler Co., Inc.*, 193 *Seventh St., Brooklyn* 15, *N. Y.*

Available in 16 sizes, oil or gas fired; steam capacities rated from 3870 to 45,000 sq ft EDR; water capacities from 6190 to 72,000 sq ft EDR; working pressures with steam are 15 psi, with water 30 psi; unit also available for 100 psi water working pressure.

Propeller Fans . . .

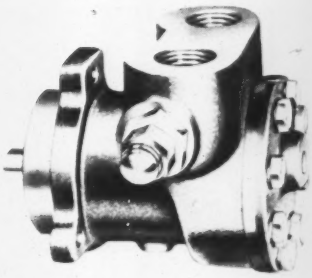
. . . rated from 45,000 to 175,000 cfm — *Monarch Electric Co., New Britain, Conn.*

Available in 6, 7, 8 ft diam with open, totally enclosed, or explosion-proof motors from ½ to 20 hp for all single or three phase systems; spark-proof belts and blades furnished with explosion-proof units.

Turbine Pump . . .

. . . designed for cooling towers, circulating, or process pumping—*Allis Chalmers Mfg. Co., Milwaukee* 1, *Wisc.*

Available in 40 sizes with ratings of 20 to 8000 gpm at heads to 400 ft and over, depending on number of stages. Bulletin "08B9409" available on request.



Rotary Pump . . .

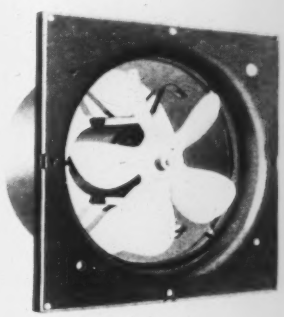
. . . features spring loaded single lip seal—*Tuthill Pump Co.*, 947 *E. 95th St., Chicago*, 19.

Furnished in 6 sizes with capacities to 6 gpm for pressures to 500 psi at 3600 rpm; can be used in hydraulic, fuel oil, and lubricating applications.

Dial Thermometer . . .

. . . featuring increased dial readability for ranges up to 1100 F—*Partlow Corp.*, 524 *Campion Rd., New Hartford, N. Y.*

Designed with reinforced plastic case and can be either flush or wall mounted; elements of same scale range are interchangeable allowing field replacement.



Tubeaxial Fan . . .

. . . designed for ventilating electronic equipment—*American-Standard Industrial Div., Detroit* 32, *Mich.*

Unit powered by 1/70 hp shaded pole electric motor operating on 115 v, single phase, 60/50 cycle current;

at rated speed will deliver 450 cfm of air at zero static pressure and 100 cfm of air at 0.22 in. w.g. static pressure; unit weighs 8 lb; installs in 9 in. circular opening with 11½ × 11½ in. mounting plate.

Control Valves . . .

. . . with removable plugs and seats for ease of maintenance—*Uniflow Valve Corp., 60 Quine St., Cranford, N. J.*

In ¼ to 1 in. screwed or flanged sizes; body rating 15,000 psi in steel, stainless steel, monel; descriptive bulletin "116" available on request.

Spray Nozzles . . .

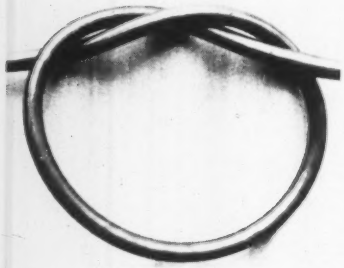
. . . for spraying corrosive liquids—*Spraying Systems Co., 3219 Randolph St., Bellwood, Ill.*

Produces hollow cone spray pattern; atomization is accomplished through hydraulic pressure; range of capacities are offered from one to 26 gph based on operation at 40 psi; all parts made of hard rubber. Data Sheet "8255" available on request.

Dial Thermometer . . .

. . . for laboratory and industrial applications—*Testing Machines, Inc., 72 Jericho Turnpike, Mineola, Long Island, New York.*

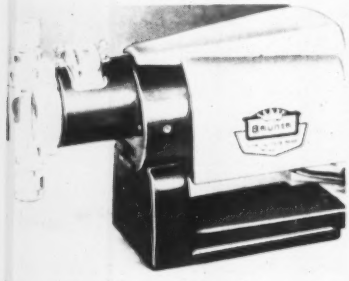
Designed so that, whenever temperature goes above or below predetermined point, electric impulse is delivered; furnished in wide ranges with single or double adjustable controls.



Heat Exchanger Tube . . .

. . . resulting from five years of testing—*Babcock & Wilcox Co., Boiler Div., 161 E. 42nd St., New York 17.*

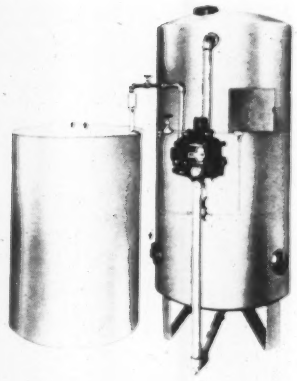
For use in boiler and pressure application requirements; consisting of improved welded steel tubing which meets all applicable codes.



Chemical Feed Pump . . .

. . . for use in corrosion control and in water treatment—*Bruner Corp., 4763 N. 32nd St., Milwaukee 9, Wis.*

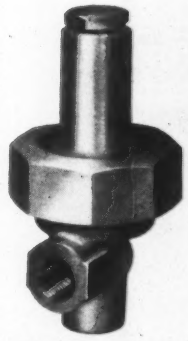
Provides constant feed adjustable up to 17 gal per 24 hr and is adjustable while in operation. Parts in contact with chemicals are plastic or rubber. Descriptive bulletin "5-619" available on request.



Water Softener . . .

. . . for commercial uses—*Universal Water Softener Co., 28 N. Bennett St., Geneva, Ill.*

Available in two series; one series uses solo valve operation; second series equipped with fully automatic operation from electric time clock; features include high capacity softening mineral, heavy duty galvanized tanks and automatic backwash controller.



PVC Relief Valves . . .

. . . for corrosion resistant applications—*Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa.*

Made in ¼ and ½ in. sizes to withstand pressures to 400 psi at 68 F and to 200 psi at 140 F; designed to insure tight shutoff below set pressure; all internal parts can be cleaned or replaced without removing valve from line.

US RUBBER EXPANSION JOINTS

How to keep your cost accountant contented

Just ask him to amortize the cost of a U.S. Rubber Expansion Joint.

He will have a pleasant time discovering that these joints never seem to wear out. Some have been in use for 30 years and are as sturdy as ever. No other rubber expansion joints have been in use that long.

"U.S." Expansion Joints are the only joints that have withstood this test of time. As for value, "U.S." Expansion Joints remain the cost accountant's delight. Other so-called "just-as-good" joints costing a few dollars less can rob you of many times their complete cost when they cause downtime.

Your accountant will tell you that "U.S." Expansion Joints comprise shrewd, logical insurance. These joints are the economical, flexible connections used in all kinds of pipe lines to take care of misalignment, vibration, expansion, contraction and noise transmission. No moving parts to wear or bind; can be installed on new or old equipment.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

US RUBBER

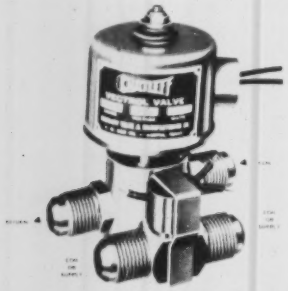
Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

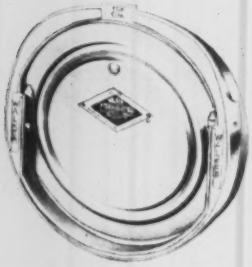
EQUIPMENT DEVELOPMENTS
Continued



Control Valve . . .

. . .for hot and cold water circuits—*Chatleff Valve & Mfg. Co., P. O. Box 966, Austin, Texas.*

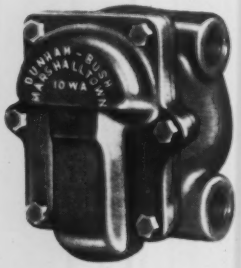
Consists of three components, available separately; valve unit is flare fitted and may be serviced completely without removal from water lines.



Draft Regulator . . .

. . .with foul-proof and corrosion proof vane adjustment—*Walker Mfg. & Sales Corp.*, 1705 *Penn St., St. Joseph, Mo.*

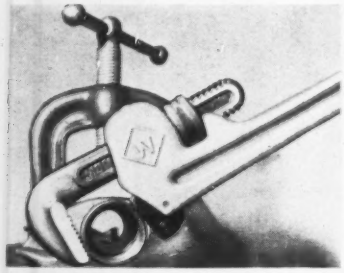
Featuring all-over range of obtainable draft values varying from 0.005 to 0.15 in. water gage; made with cast aluminum frame and aluminized steel damper; prebalanced; improved vane stop softens closure noise.



Steam Traps . . .

. . .designed for inspection without disturbing pipe connections—*Dunham-Bush, Inc.*, 179 *South St., West Hartford* 10, *Conn.*

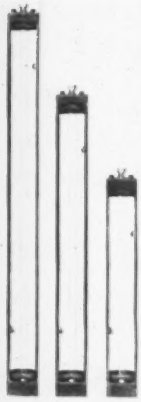
Available for low pressure or subatmospheric steam heating systems and steam process equipment; used for pressures up to 15 psi; medium and high pressure systems up to 30, 75, 125 psi; data sheets including applications, features, capacities, dimensions, and weights available on request.



Pipe Wrench . . .

. . .of self-adjusting design—*Wheeler Mfg. Corp., Ross Rd., Ashtabula, O.*

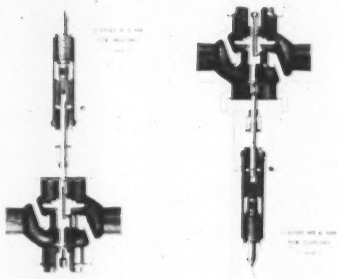
Features sliding lower jaw that automatically tightens grip as force is applied; takes up variations of adjustment resulting from rough handling; available in sizes from 10 to 24 in.



Pressure Gages . . .

. . .for static or differential pressures —*Meriam Instrument Co.*, 10920 *Madison Ave., Cleveland* 2, *O.*

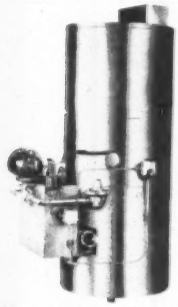
With ranges of 8, 12, 16 in. to measure maximum static pressures of 4, 6, 8 psi, respectively; reads in both inches and tenths, and pounds and tenths; indicating tube made of heavy-wall, heat resistant glass; more details available in bulletin "P-10" on request.



Temperature Regulator . .

. . .designed for steam and water service—*Leslie Co.*, 271 *Delafield Ave., Lyndhurst, N.J.*

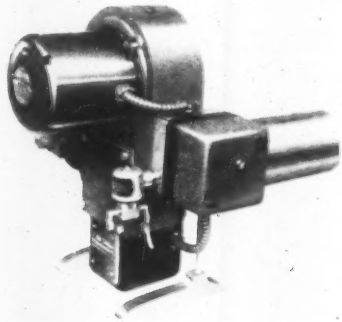
Manufactured in 3/4 and 1 in. cast iron and bronze body sizes with screwed ends; inlet pressures and pressure drops up to 100 psi; complete sizing and capacity data available in bulletin "591" on request.



Water Heater . . .

. . .featuring solid copper firing tubes —*Sellers Engineering Co.*, 4876 *N. Clark St., Chicago* 40.

Vertical package models in two types: direct fired provided with solid copper tubes, equipped with copper tube heat exchanger and steel firing tubes. Descriptive bulletin "5211" available on request.



Power Gas Burner . . .

. . .designed for conversion of large furnaces and boilers—*Liberty Com-*

B&W JOB-MATCHED WELDING FITTINGS

make piping systems permanent and leakproof

. . . you get positive fit-up to pipe which means welding is easier, faster and more sure

. . . you get dimensional accuracy which means that, with a sound weld, piping is maintenance-free for the life of the system

. . . you get extra long life because you can choose the correct steel for your application

Specify B&W Welding Fittings and Flanges on your next piping job. They're available in a complete range of types and sizes in carbon steel and, of course, the famous B&W CROLOYS. Call your local B&W District Sales Office or any qualified welding fittings distributor. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

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TUBULAR PRODUCTS DIVISION

TA 9025-WF3

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

"from Chicago"

the new "IMMERSIPUMP"* SUBMERSIBLE NON-CLOG SEWAGE and SUMP PUMP

*Trademark

- Low Original Cost
- Low Maintenance Cost
- Easy To Install
- Easy To Service
- Pump And Motor Operate Completely Submerged

FOR Pumping Sewage And Other Liquids Containing Solids . . . and Sump Pump Applications

The new "Chicago" IMMERSIPUMP* is a development of 50 years of experience in the research, engineering and manufacture of sewage and sump pumps for buildings, industrial plants and municipalities.

The finest materials are used . . . to assure years of trouble-free service. No superstructures are required for outdoor installations . . . minimum head room is required for indoor installations. The Stainless Steel Bail enables easy installation and removal of the unit. The enclosed Non-Clog pump impeller passes solids up to 2½". The pump casing is made of close-grained, cast iron . . . the shaft of Stainless Steel. A separate Suction Plate, with tripod, is furnished to support the entire unit . . . enabling easy, quick access to the Impeller.

The Motor is specially designed for submersible operation . . . being totally-enclosed and oil filled to positively assure against water entering the unit.

. . . *available with the new* SEALTRODE* Sealed Electrode Floatless Pump Controller . . . the *only* Controller featuring completely sealed Electrodes . . . positively preventing insulation or coating by grease or other corrosive elements.

"Chicago" Distributors are located in most principal cities. See the one nearest you today for full details.

1959 50 YEARS 1909 CHICAGO PUMP COMPANY

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

Chicago Pump Company

6220 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

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EQUIPMENT DEVELOPMENTS

Continued

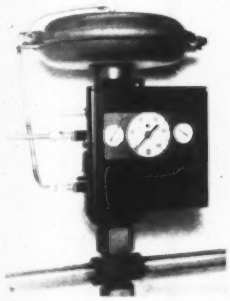
bustion Corp., Industrial Park, P. O. Box 300, Syracuse, N. Y.

Inshot type design; burns all gases; intermittent pilot, electric ignition; electronic safety controls are standard equipment; three models available with 400,000; 700,000; 1 million Btu per hr input.

Expansion Joints . . .

. . . for absorbing pipeline movement without imposing pressure thrust—*Zallea Brothers, 815 Locust St., Wilmington 99, Del.*

Available in 3 in. to 50 ft diam for temperatures from −320 to 1600 F and pressures up to 2500 psi; special units available for more severe conditions with a variety of bellows; installed at elbows or points where piping changes direction; uses counterbalancing outer bellows to absorb line pressure where anchoring is not practical.



Valve Positioner . . .

. . . incorporates pilot to sense valve travel—*U. S. Gauge Div. of American Machine and Metals, Inc., Sellersville, Pa.*

Designed in combination with indicating pneumatic controller; combination unit is in 8½ in. sq case; can be mounted on side of any make of diaphragm motor valve with stem travel from ⅜ to 4 in.

EQUIPMENT DEVELOPMENTS

Continued

Plastic Ball Valves . . .

. . . for corrosion resistant applications—*B. F. Goodrich Chemical Co., 3135 Euclid Ave., Cleveland 15, O.*

Made of rigid vinyl except for seats and seals; available with threaded ends or flanges; self-compensating for changes in pressure or temperature; needs no lubrication.

Air Conditioning Starter . . .

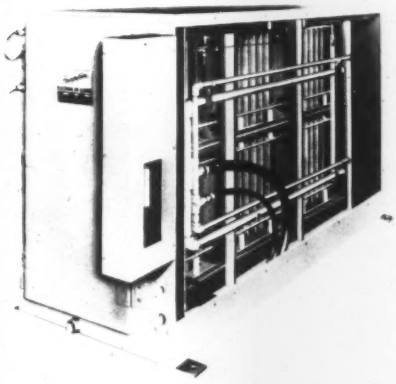
. . . for control of air conditioning compressor motors —*General Electric Co., Dept. HPAC, Schenectady 5, N.Y.*

For compressor motors from 7½ to 20 hp, starters rated at 50 and 60 amp at, 110/220 volts; or 25 and 30 amps, 440 550 volts. Starters available with overload relays.

Power Root Exhausters . . .

. . . featuring corrosion proof construction, quiet operation — *The Gallaher Co., 4108 Dodge St., Omaha 31, Neb.*

Rated from 55 to 585 cfm at static pressure of 0.125 in water gage; shaft inputs range from 11 to 35 watts; single phase motors; bulletin available on request contains rating table, dimensions, other data.



Electronic Air Cleaners . . .

. . . for air flow rates from 1950 to 28,800 cfm—*Westinghouse Sturtevant Div., Dept. T-262, 200 Readville St., Hyde Park, Boston 26, Mass.*

Designed for coil face velocities between 350 and 600 fpm; can be installed as integral part of air distributing units; depth of unit is 25½ in.; collector plates may be washed manually or automatically; collected dust thus flushed and drained away, without any need to enter ductwork; completely factory built; ready for floor, platform, or ceiling mounting; only high voltage connection is from power pack to terminal on cabinet.

INDEPENDENT

"Fabrikated"

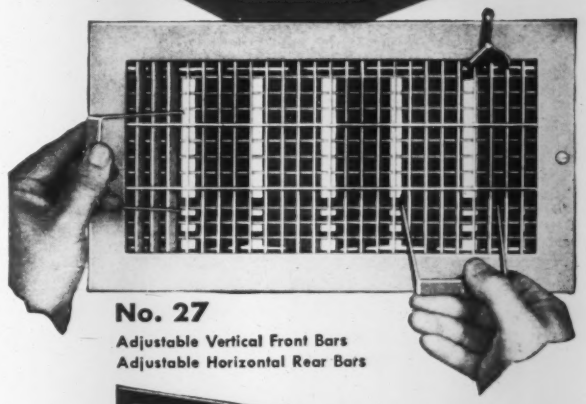
REG. U. S. PAT. OFFICE

DOUBLE CORE REGISTERS

With opposed blade dampers

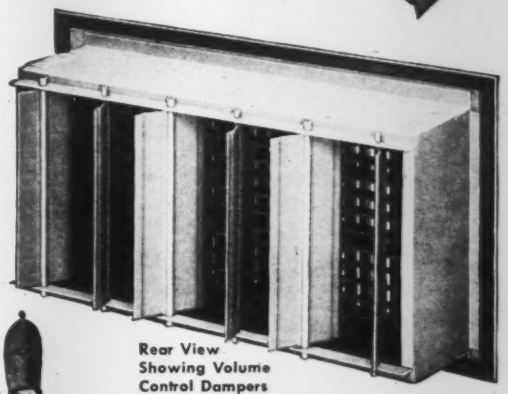
Key control

For Commercial Installations



No. 27

Adjustable Vertical Front Bars
Adjustable Horizontal Rear Bars



Rear View
Showing Volume
Control Dampers

Write for Catalog
No. 58 which gives
complete details and sizes
up to 48" x 24"

Always leading—Always Progressing

THE INDEPENDENT
REGISTER CO.
3747 E. 93rd STREET • CLEVELAND, OHIO

Keep pace with your space . . .

CYCLOTHERM

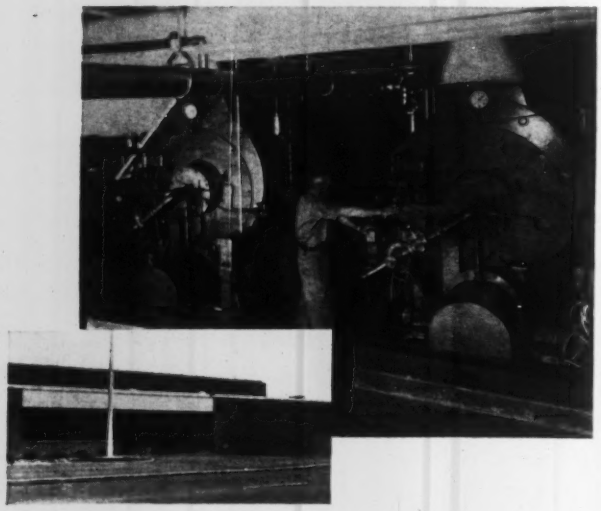
provides for tomorrow's heating today

The Cyclotherm you install today will meet your steam requirements for many years to come. But time does fly and businesses do grow. And when you make a plant addition 18 Cyclotherm models, with 18 different boiler horsepowers, are ready to match new space with new heating capacity.

The Cyclotherm Steam and Hot Water Generator is built under one roof with one manufacturing responsibility backing the entire equipment—shipped fire-tested and ready to operate. Up to ⅓ smaller than other package generators of same capacities and needing no excavation, no foundation, no costly stack.

Electronic controls operate the Cyclotherm automatically. On units of 80 HP or more, modulation controls regulate firing rate from 30% to 100% of rated capacity without loss of efficiency. Smaller models automatically *off* when steam demands are satisfied, automatically *on* when more steam is needed. Operation stops if firing sequence is interrupted and unit fails safe. Cyclotherm cuts maintenance costs by up to 50%.

Cyclotherm meets all state requirements, conforms to A.S.M.E. and National Board standards, carries Underwriters' Laboratories label. Burns oil and/or gas. Steam generators: 15 to 750 HP. Hot water Generators: 670,000 to 6,700,000 BTU per hr.



At the Frederick Leighton School, Oswego, N. Y., two 100 HP Cyclotherms keep 21 classrooms and 550 pupils warm and comfortable. Building designed by Ketcham-Miller-Arnold Architects of Syracuse, N. Y.; Consulting Engineer Cedric R. Acheson, also of Syracuse.

YEARS AHEAD IN STEAM & HOT WATER GENERATION

CYCLOTHERM® Steam & Hot Water Generators

Division of National-U.S. Radiator Corp.
55 E. First St., Oswego, N. Y.

Clip to Your Letterhead:

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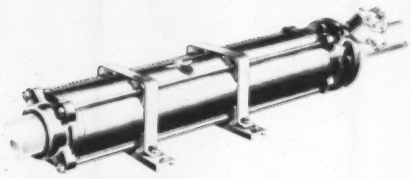
Please send me full information about Cyclotherm Steam and Hot Water Generators.

EQUIPMENT DEVELOPMENTS

Continued



In-Line Pump . . .

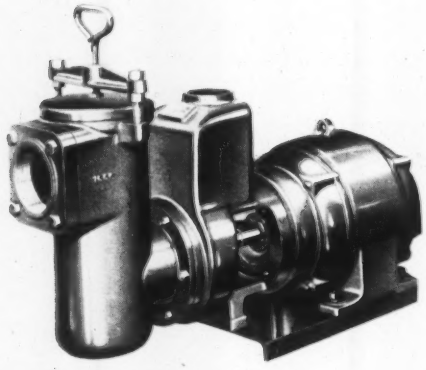
. . . of submersible design — *Red Jacket Mfg. Co., 1051 S. Rolff St., Davenport, Iowa.*

Available in 6 models in 1, 1½, 2, 3, 5 hp with capacities up to 260 gpm; designed to handle petroleum and commercial solvents and other liquids; can be mounted vertically or horizontally; bulletin "PIL-1" with full information available on request.

Load Limiting Relay . . .

. . . providing protection of centrifugal refrigeration compressors from overload on start-up—*Johnson Service Co., 507 E. Michigan St., Milwaukee 1, Wis.*

Limit device is connected in control line to suction damper operator and limits output capacity of compressor to full load ampere rating; designed for pneumatic control systems and for use with all makes of compressors; can be adjusted for current values between 3 and 7 amps; may also be applied to fans, pumps, electric heating systems; complete details available in bulletin "V-26" on request.



Centrifugal Pump . . .

. . . self-priming and available in either bronze or cast iron — *Hydro-pump, Inc., 165 S. Fair Oaks Ave., Pasadena, Calif.*

Available in 3, 5, 7½, 10, and 15 hp sizes; suction pipe size 3 in. and discharge 2 in. on smaller units; suction 4 in. and discharge 3 in. on larger models; all electric motors are 208-220/440 v, 60 cycle, 3 phase, 3600 rpm.

Expansion and contraction of the plastic pipe is controlled by rubber shock cords connected to hooks on the rink rim.

Skating Rink—Dance Floor features freezing system of polyethylene pipe

At this convertible ice skating rink, installed by the Kalamazoo, Michigan, Parks Department, city residents can frolic all year 'round.

Eleven miles of USS National Polyethylene Pipe, NSF Grade, make up the brine-circulating system—3,700 gallons of brine at 35 psi. The lightweight plastic pipe can be removed in just one day to permit dancing or roller skating on the rink's smooth floor. When not in use, the pipe, with 2,640 gallons of the brine still in it, is stored in a trench next to the rink.

Installation of the pipe was completed in two days by a crew who had no previous experience installing a freezing system of polyethylene pipe. The pipe has a 1″ inside diameter and a wall thickness of only 1/10 of an inch. Its glass-smooth inner walls greatly reduce friction and minimize pumping problems. When the pipe is disconnected in the Spring, each 185-foot loop, including the brine, will weigh about 110 pounds—light enough to permit easy handling by a small crew.

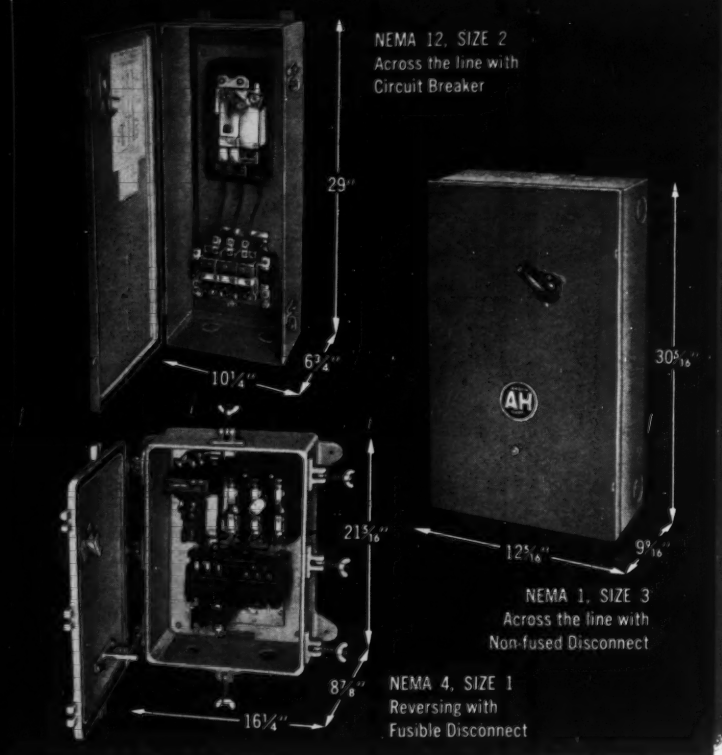
USS National Polyethylene Pipe, NSF Grade, can't be harmed by most acids, salts, alkalis or other chemicals. It remains flexible in temperatures from −90°F. to +120°F. The pipe is made from 100% virgin polyethylene to which 2% of an inert black pigment filler has been added to prevent deterioration from ultraviolet rays.

For full information, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. Ask for Bulletin No. 29. *USS and National are registered trademarks*

"The world's largest and most experienced manufacturer of tubular products"

National Tube Division of USS United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Export Company, New York



Announcing: **A COMPLETE LINE OF COMPACT, LIGHTWEIGHT COMBINATION STARTERS**

Sizes 0, 1, 2, and New Sizes 3 and 4 — and NEW CAST ALUMINUM WEATHERPROOF and EXPLOSIONPROOF ENCLOSURES

Starters are of exclusive "Right Angle" Design which brings important installation, maintenance and performance benefits. For convenience and safety, unit is front operated by means of Fused or Unfused Disconnect, or Circuit Breaker. Circuit Breakers are Instantaneous or Thermal Magnetic Trip Types. *No other line offers enclosures that facilitate mounting and handling like the new cast aluminum NEMA 4 Weatherproof and NEMA 7 and 9 Explosionproof — Enclosures that are one-half the weight of old-style cast iron boxes.* Other available enclosures: General Purpose (NEMA 1) and Industrial (NEMA 12 — oil-tight and dust resistant).

Write for new folder on A-H Combination Starters to: The Arrow-Hart & Hegeman Electric Company, Dept. HPAC, 103 Hawthorn St., Hartford 6, Conn.

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Quality since 1890

MOTOR CONTROLS · ENCLOSED SWITCHES
APPLIANCE SWITCHES · WIRING DEVICES

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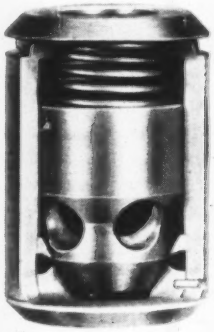
EQUIPMENT DEVELOPMENTS

Continued

Wind Instrument . . .

. . . to measure vertical and horizontal air velocity components for air pollution studies—*Gelman Instrument Co., P. O. Box 86, Chelsea, Mich.*

Maximum overshoot of wind vane is 15 percent; permanent record obtained from companion recorder.



Check Valve . . .

. . . for pump suction inlets, pump conversions—*Kepner Products Co., 7303 W. 59th St., Summit, Ill.*

Constructed of steel for use with oils, air lubricants, and water with working pressures up to 3000 psi, temperatures from −40 to 300 F with cracking pressure of 1 to 2 psig; descriptive literature available on request.

Belts and Pulleys . . .

. . . combining advantages of chain and gear with those of belt—*Worthington Corp., Harrison, N. J.*

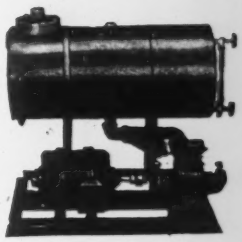
Available on drives up to 600 hp

Skidmore Pumps gives PEAK PERFORMANCE — Right Down the Line!

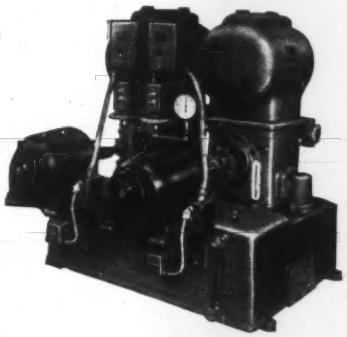
Skidmore Corporation's complete line of heating pumps affords a type and capacity for every general or special installation. Available in both single or duplex units with close-coupled and mechanical shaft-seal. Low installation cost and maintenance with peak performance are assured from every type or size—Right Down the Line.

"UV" TYPE

"HS" TYPE

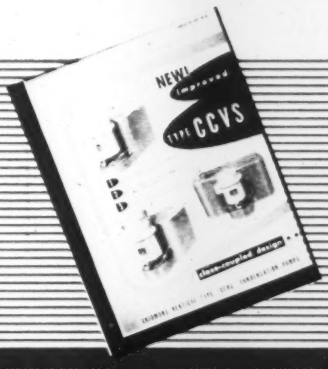


"TM" TURBINE



The Skidmore Vacuum and Boiler Feed Pump is famous for "maintained efficiency" . . . liberal clearance between moving parts positively eliminates wear. Capacities range from 5,000 to 100,000 sq. ft. EDR.

SEND FOR BULLETINS



Send for Bulletin No. 21-C

The new SKIDMORE CCVS Vertical Pump features *close-coupled* design and *mechanical shaft-seal*. The single unit is built with 5, 10 and 20 gallon receivers. The duplex unit is designed with two float switches or automatic alternator. Capacities for the new CCVS Pump range from 500 to 10,000 sq. ft. E.D.R. Write for complete engineering data.

TYPE CCVS

Sales Representatives in Principal Cities

Since 1921

SKIDMORE PUMPS

SKIDMORE CORPORATION

ST. JOSEPH, MICHIGAN

Life in these excited states...

"Sunday morning is no time to call me about a little leak"

For Men Who Work 24 Hours a Day

Like the phone ringing when you're in the shower, corrosion and contamination wait for no man. Best way to confine it to normal working hours is to specify trouble-free Ace chemical-resistant equipment by American Hard Rubber Company. Best for the money anywhere... backed by 108 years of experience.

RIVICLOR
for ageless strength

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*

NEW
ACE Gear Pump

Improved design... now 12 gpm. All wetted parts acid-resistant, wear-resistant Ace hard rubber. Finest available. *Bul. CE-55.*

SUPPLEX
tops in economy

Flexible poly pipe, ideal for water lines, drains, underground pipe or conduit. Sizes ½ to 2", long coils, NSF-approved for drinking water. *Bul. CE-57.*

VALVE HEADQUARTERS

World's best chemical valves ... at moderate prices. All-plastic, rubber-lined, or all-hard-rubber, ⅛" pet cocks to 24" gate valves.

ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
DIVISION OF AMERACE CORPORATION
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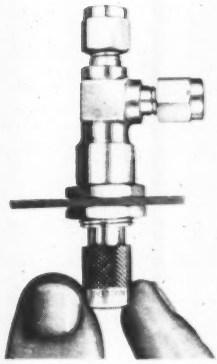
EQUIPMENT DEVELOPMENTS
Continued

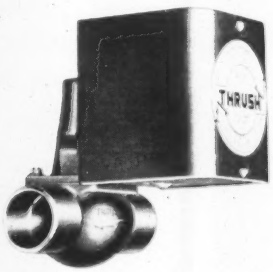
and from speeds under 100 fpm to over 10,000 fpm. Drives built on tooth-grip principle.



Metering Valve . . .

. . . featuring 40 pitch thread and needlepoint flow control—*Nuclear Products Co., 15635 Saranac Rd., Cleveland 10, O.*

Air flow rate ranges from 0 to 4000 cm per min; applicable for gas analyses and sampling lines; each valve has stainless steel 316 stem; valve available in brass or stainless steel.



Zone Valve . . .

. . . for hot water heating and cooling systems—*H. A. Thrush Co., Peru, Ind.*

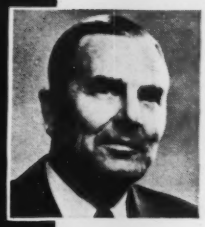
Operates from standard thermostats and relays; comes in ¾ and 1 in. sizes; all parts in contact with water are noncorrosive; opens and closes gradually eliminating water hammer and noise; descriptive literature available on request.

Reading Tube Corp. Congratulates

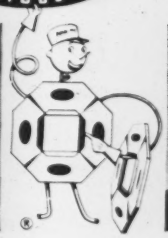
Mr. A. B. CARTER and Mr. Sam P. WALLACE

for a BIG JOB Well Done!

READING COPPER BRASS TUBE AND RED BRASS PIPE



A. B. Carter, Pres.
Farwell Co., Inc.
Dallas, Texas



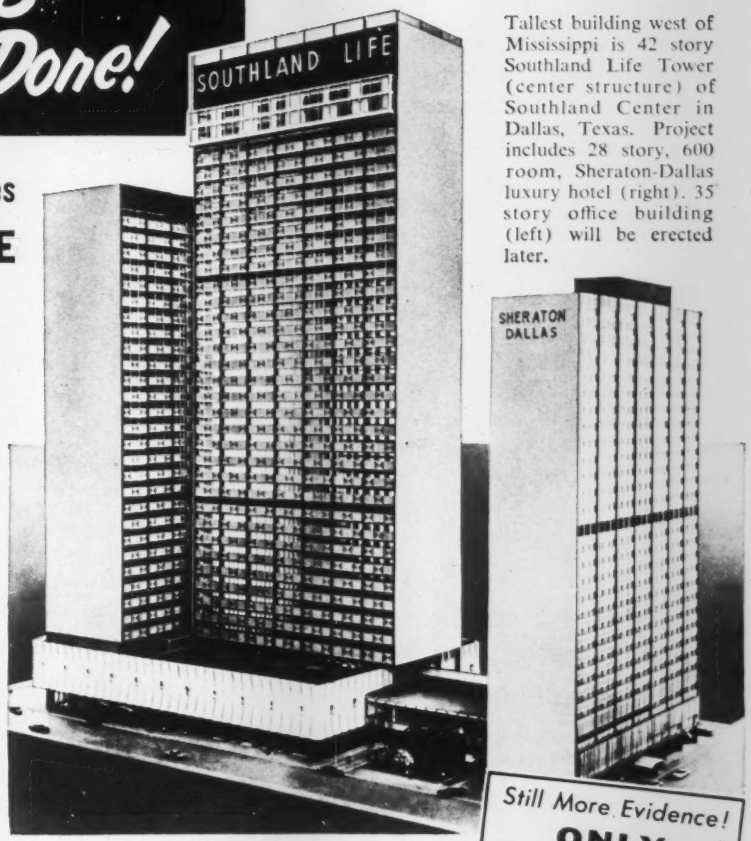
Sam P. Wallace
Sam P. Wallace & Co.
Dallas, Texas

Dallas' Huge Southland Center Uses

READING COPPER TUBE *Exclusively* for Plumbing and Heating

A. B. Carter and Sam P. Wallace have used millions of feet of Reading Copper Tube for jobs all over the U.S.A. As the two successful bidders for the contract, they joined forces and formed the Farwell-Wallace Joint Venturers, to handle the work.

Based on their gratifying past experience, they used Reading Copper Tube exclusively, a total of over 100 tons. (Architects and engineers—Welton Becket & Associates; consulting mechanical engineers — Zumwalt & Vinther, Dallas; project manager—S. E. Ammons; project superintendent —Joe Sumner; Reading Tube Distributor — International Supply Co. of Dallas.)



Tallest building west of Mississippi is 42 story Southland Life Tower (center structure) of Southland Center in Dallas, Texas. Project includes 28 story, 600 room, Sheraton-Dallas luxury hotel (right). 35 story office building (left) will be erected later.

More Evidence That
In Tubing—Nothing Beats Copper!
In Copper Tubing—
Nothing Beats READING!

Still More Evidence!
ONLY READING COPPER TUBE Used in Valve Assemblies for 2300 CARRIER WEATHERMASTER Air Conditioning Units at SOUTHLAND CENTER!

Always Specify READING COPPER TUBE

READING TUBE CORPORATION EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
PLANT: READING, PA.

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

Distribution Depots:

READING, PA.	**WOODSIDE, L. I., N.Y.** 57-17 Northern Blvd.	**PHILADELPHIA, PA.** 921 Penn St.	**CHICAGO, ILL.** 305 W. 31st. St.	**CLEVELAND, OHIO** 4615 Perkins Ave.	**DALLAS, TEXAS** 9000 Sovereign Row Brook Hollow Industrial District
ATLANTA, GA. 690 Murphy Ave. S.W., Unit 5, Bldg. B.	**OAKLAND, CALIF.** 410 Hegenberger Rd.	**LOS ANGELES, CALIF.** 130 No. Santa Fe Ave.	**DENVER, COLO.** 2845 Walnut St.	**HOUSTON, TEXAS** 1121 Rothwell St.	

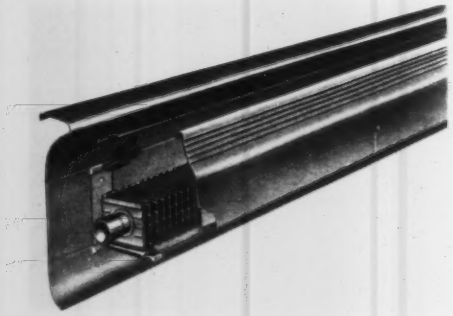
EQUIPMENT DEVELOPMENTS

Continued

Relief Valve . . .

. . . for applications where it is important to know if pressure has opened valve momentarily—*George W. Dahl Co., Inc., Tupelo St., Bristol, R. I.*

Features indicating pin which pops out of compact body at instant valve opens; pressure adjustment at top of bonnet can be furnished for relief settings from 3 to 100 psi; available with NPT connections from 1/16 to ½ in.



Baseboard Tubing . . .

. . . for zone control hot water heating systems — *Edwards Engineering Corp., Dept. HPAC, 101 Alexander Ave., Pompton Plains, N.J.*

In new ½ in. size with industry-approved ratings. Available in lengths from 2 to 20 ft with covers to minimize noise in copper-tone, chrome, flat white, or woodgrain finish.

Tubing Tools . . .

. . . for use on aluminum, brass, and copper tubing for "sweat-type" fittings — *Imperial Brass Mfg. Co., 6300 W. Howard St., Chicago 48.*

For cutting, flaring, swaging ½, ⅝, ⅞ in. OD tubing; descriptive supplement to catalog "3088" available on request.

Pressure Gages . . .

. . . made in all standard pressure ranges, and in compound and vacuum types—*Marsh Instrument Co., 3501 Howard St., Skokie, Ill.*

Accuracy guaranteed to ± 0.25 percent of maximum dial reading over entire range; dial sizes available in 4½, 6, 8 in.; more details available in manufacturer's bulletin available on request.

YOUR IDEAS WORK BETTER WHEN YOU WORK WITH HONEYWELL

THE FOLLOWING pages bring you some of the latest developments in automatic controls from Honeywell. They widen your choice of products; give you more to work with.

For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 sales offices throughout the country. Each is staffed with control specialists to assist you in writing specifications and preparing control layouts.

Now! A master control for your central fan system—

New Honeywell Transistorized control com

Five adjustment knobs give you finger-tip control of duct temperature from one location

- Adjustment for throttling range of controlling thermostat
- Factory calibration adjustment knob
- Adjustment for outdoor air thermostat effect
- Adjustment for second thermostat effect
- Adjustment for calibration and control point

The following additional features offer you extra protection, extra convenience: rugged mounting case made of 16-gauge steel, reinforced top and bottom; hinged, swing-out panel for easier servicing; easy-to-read terminal connections that reduce chances of wiring errors; separate terminal strip for panel power; ample number of knockouts (seven at top, seven at bottom) for easier installation.

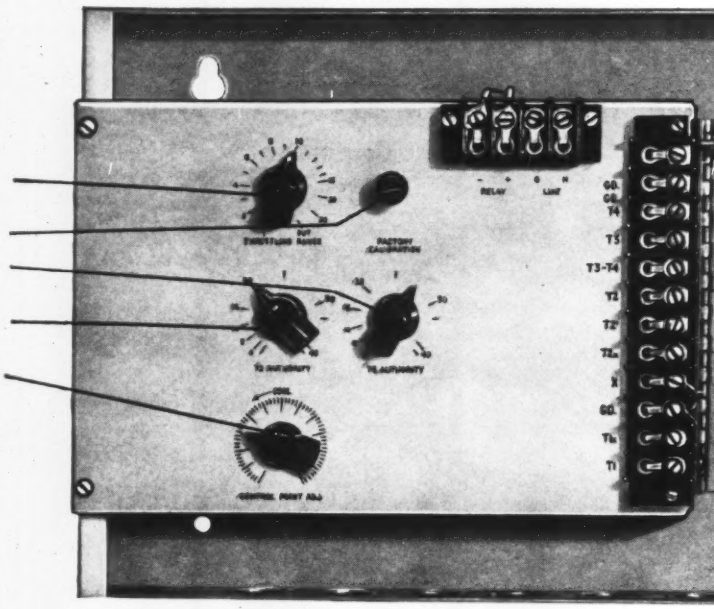
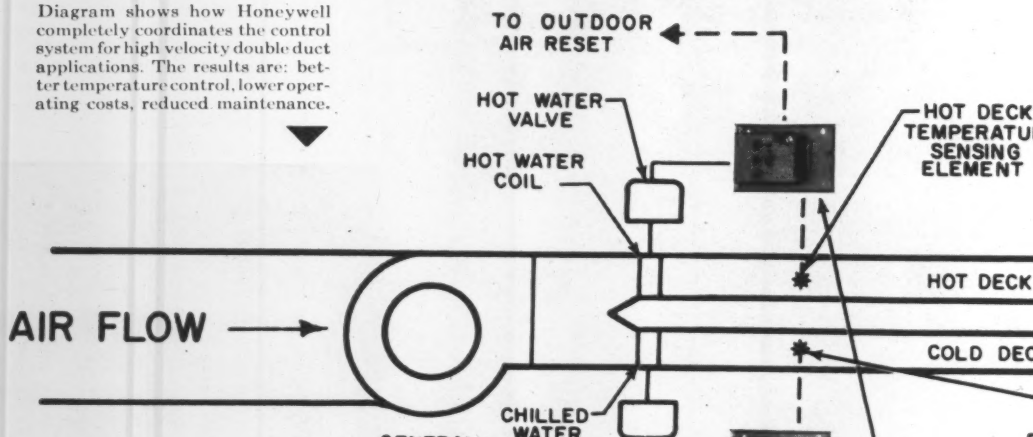
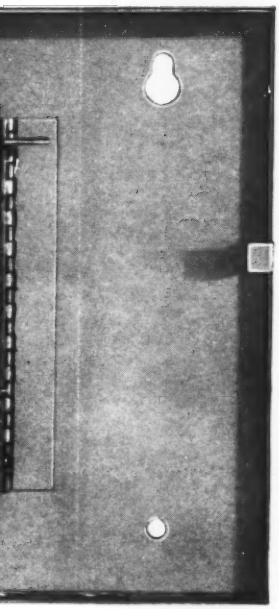


Diagram shows how Honeywell completely coordinates the control system for high velocity double duct applications. The results are: better temperature control, lower operating costs, reduced maintenance.



mbines the best of electronics and pneumatics!



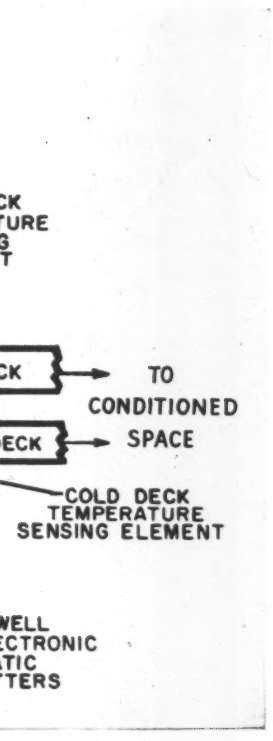
This new relay combines the sensitivity and versatility of electronic sensing with the powerful, rugged economy of pneumatic actuation—your assurance of better control performance!

Now you can completely co-ordinate the control of your air conditioning system from a single location! The new Honeywell Electronic-Pneumatic Transmitter eliminates difficult, inexact adjustments at sensor locations—and, there's a free choice of locations because sensors are now adjusted at the central panel.

This new relay combines the sensitivity, freedom from ambient temperature effect, fast response and versatility of *electronic sensing* with the powerful, rugged economy of *pneumatic actuation*. It's the perfect combination of functional advantages needed to do a better control job for you.

Two compact, rugged transistors handle the R07903's power load with plenty to spare—your assurance of trouble-free performance and longer life.

Honeywell's new Electronic-Pneumatic Transmitter offers you a choice of specialized sensing elements as shown below. For more information about the many ways the R07903 can serve you, call your nearest Honeywell office today or write Minneapolis-Honeywell, Dept. AC-10-141, Minneapolis 8, Minnesota.



Honeywell offers you a wide choice of specialized sensing elements for use with the R07903 transmitter!

These elements have no moving parts, require no adjustments and provide faster, more accurate response. They are simple coils of temperature sensitive wire—dustproof, tamperproof, foolproof—that insure your systems long years of dependable, trouble-free service.

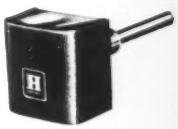
Relay connections are made with simple, standard low-voltage wiring, and can be manufactured in various shapes and sizes for easy fitting to each individual installation. Element lengths for duct measurements vary from 4 inches to a special averaging model of 27 feet.

INSERTION ELEMENTS

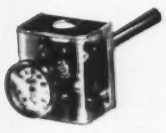
DUCT ELEMENTS

OUTDOOR ELEMENT

AVERAGING DUCT ELEMENT



INSERTION ELEMENT



DUCT ELEMENT

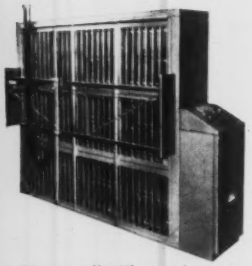
DUAL-ACTING DISCHARGE ELEMENT

NOW! FLUTTER-JET WASHING
Another first for Honeywell's
ELECTRONIC AIR CLEANER

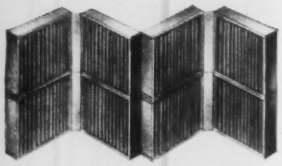
Actual unretouched strobelight photograph taken at 1/2,000 second.

Never before such a quick, efficient way to wash electronic air cleaners! Honeywell's new flutter jet washer literally *blasts* water throughout the air cleaner, with a fluttering, sweeping action that flushes away accumulated dirt quickly—cleans every part thoroughly. The new flutter jet nozzle never clogs.

Honeywell's Electronic Air Cleaner
Removes 90% or more of all airborne dirt



Honeywell's Electronic Air Cleaner



Honeywell's Activated Charcoal Filter

You can now select from three types of cells: (1) *Hi Velocity*—for 90% or more dirt removal or where space is limited. (2) *Standard*—for normal conditions, provides high efficiency dirt removal and high dirt capacity. (3) *Hi Load* for handling high dirt concentration.

With these 3 different cell capacities, you can have complete freedom in designing your plenums. Just select the cell type and number of cells that will give you the air cleaning capacity you need in the plenum space available. No longer is it necessary to design your plenum to fit the air cleaner.

Remove Odors, Too

For the ultimate in air cleaning, team up Honeywell's Electronic Air Cleaner with the Activated Charcoal Filter—for removal of *all odors and gases*, too. Only Honeywell offers this *exclusive* combination.

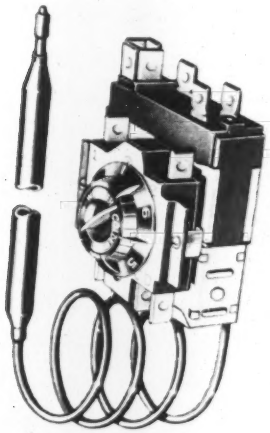
For more information about Honeywell air cleaning, call your nearest Honeywell office. Or write: Minneapolis-Honeywell, Dept. AC-10-111 Minneapolis 8, Minn.

Honeywell

H HONEYWELL First in Control

EQUIPMENT DEVELOPMENTS

Continued



Cycling Thermostats . . .

. . . permitting side access to terminals — *Ranco, Inc., 601 W. Fifth Ave., Columbus 1, O.*

For air conditioners, compressors, strip heaters, and heat pumps; with 1, 6, or 8 dial positions; 35 F dial range; 3½ F minimum differential.

Couplings, Fittings . . .

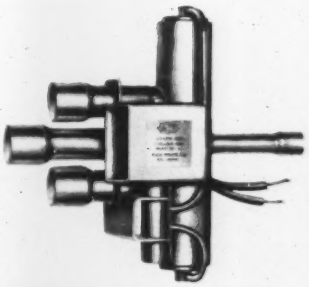
. . . for joining grooved-end pipe— *Dresser Mfg. Div., Dresser Industries, Inc., 49 Fisher Ave., Bradford, Pa.*

Available in two series, one for working pressures up to 500 psi, the other for working pressures to 1000 psi; bodies are of malleable iron and coated to prevent corrosion; track-type of heat-treated carbon steel.

Pipe Thread Tape . . .

. . . for sealing, lubricating pipe joints — *Chemtrol, 10872 Stanford Ave., Lynwood, Calif.*

Furnished in ½ in. width with 300 in. of tape in each roll; chemically inert, non-toxic, cannot contaminate liquids, resistant to heat and cold, according to manufacturer.



Pilot Valves . . .

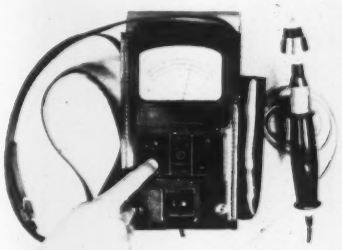
. . . for refrigeration applications— *Alco Valve Co., 365 Kingsland Ave., St. Louis 5, Mo.*

Made of cast iron and steel; designed to shift for defrost cycle while system is in operation with 300 psi differential; shifting of valve is independent of any pressure drops in valve; can be mounted in any position except upside-down.

Roof Ventilator . . .

. . . designed for heavy industrial applications—*Western Engineering & Mfg. Co., 4114 Glencoe Ave., Venice, Calif.*

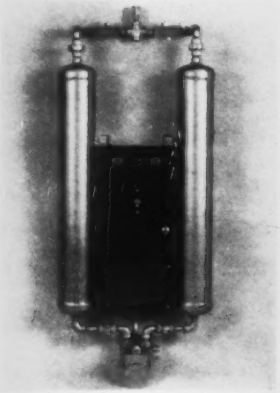
Standard units are 7 ft. 6 in. wide and 10 ft long with three operating cells each. Each unit has opening over 33 sq ft; completely weather-tight rising 21½ in. above curb.



Thermistor Probes . . .

. . . available with spring-mounted tips to assure accurate surface temperature measurements — *Atkins Technical, Inc., Dept. SM, 1276 W. Third St., Cleveland 13, O.*

Covers temperature range between —148 F and 554 F; temperature can be read in Fahrenheit or Centigrade without conversion.



Compressed Air Dryer . . .

. . . for use with instruments where dry air is essential — *Desomatic Products, Inc., 1109 W. Broad St., Falls Church, Va.*

Where a small quantity of air, from 1 to 25 cfm, at a pressure of 100 psi and 90 to 100 F inlet temperature is required; fully automatic with only two moving parts, a timer and solenoid type 4-way valve.

Portable X-Ray . . .

. . . for inspecting pipe welds — *General Electric Co., X-Ray Dept., 4855 W. Electric Ave., Milwaukee, Wis.*

Capable of inspecting welds up to 10 ft below ground surface; radiographs with 2 percent sensitivity and

q|s|p*

*Westinghouse q|s|p means quality-service-performance

. . . in products, services and programs offered to the customers of Westinghouse air conditioning and heating. q|s|p is more than a slogan. It's a pledge and a reality to those who sell and to those who buy Westinghouse products.

Quality in products—in the sales, training and promotion programs that Westinghouse provides; in the caliber of people with whom you deal; in the job Westinghouse contractors perform in installing and servicing equipment.

Service of the whole Westinghouse organization in helping contractors sell more, more profitably; the extra service given by the Westinghouse contractor and dealer to their customers; customer service, order service, replacement service and all the many others offered by Westinghouse.

Performance in every phase of business that helps your association with Westinghouse be a profitable one; performance of products in use; performance of people who are vitally interested in your needs and your customers; performance of the most modern, complete air conditioning plant in the world, manned by the most experienced workers in the industry; *performance of a full range of packaged and field-assembled equipment for all three markets—residential, commercial and industrial.*

In the months to come, you will see the graphic evidences of how Westinghouse q|s|p has built profits and reputations for the leading contractors in this industry. You will see how q|s|p becomes a powerful sales weapon for all who share the identity of Westinghouse Heating and Air Conditioning Specialists.

Westinghouse q|s|p has real meaning for contractors, specifiers and users. On your next air conditioning or heating requirement, better call Westinghouse.

J-85025-A

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

AIR CONDITIONING DIVISION, WESTINGHOUSE ELECTRIC CORPORATION, STAUNTON, VIRGINIA

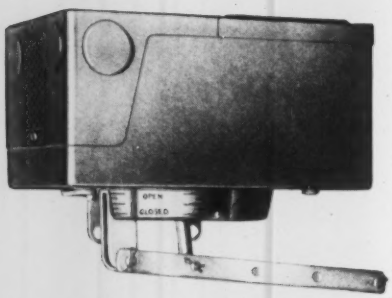
THE MARK OF QUALITY

BARBER COLMAN

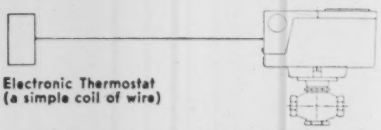
Automatic Controls

NEW!

A Transistorized Electronic Motor Operator



–with lever for air damper control



Electronic Thermostat (a simple coil of wire)

Schematic Transistorized Motor Operator (no tubes or relays)

Transistors eliminate tubes and relays giving you the benefits of electronic control at no extra cost

Now for the first time, electronic system control is available at a cost comparable with "standard commercial equipment."

The transistor operator is an electronically controlled device containing a transistorized amplifier and an operating mechanism designed for proportional operation of a valve or damper.

Virtually self-contained, the simple attachment of a two-wire sensing element to the operator forms a system of electronic control (see schematic).

Check these "plus features":

- Simplified, compact unit through the use of transistors.
- Long, trouble-free performance and low maintenance through the elimination of tubes and relays. All moving parts operate submerged in oil.
- Simplifies installation because of compactness and self-contained design.
- Spring return action provides fail-safe performance. Operator returns to "off" position in case of power failure.
- Operator can be easily converted from direct to reverse acting.

Call your Barber-Colman representative or write today for brochure F8991.

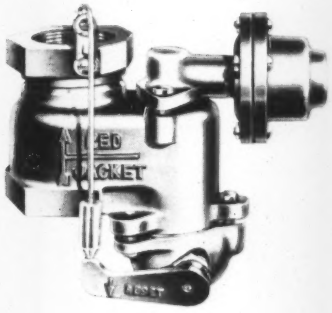
BARBER-COLMAN COMPANY

Dept. V, 1301 Rock Street, Rockford, Illinois • Field Offices in Principal Cities

EQUIPMENT DEVELOPMENTS ··

Continued

1.5 density can be produced with 1½ min exposure through 1¼ in. of steel; operates in temperature range from 0 to 120 F, relative humidity up to 95 percent and altitudes up to 5000 ft with ample effective radiation protection provided.



Check Valve . . .

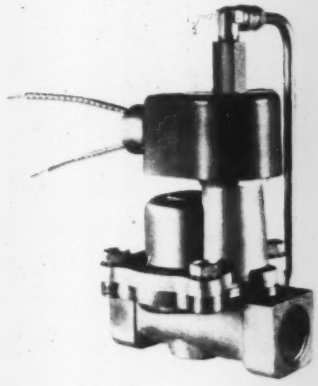
. . . featuring optional built-in leak detector for remote pumping systems — *Red Jacket Mfg. Co., 1051 S. Rolff St., Davenport, Iowa.*

Consists of spring-loaded valve with arm held open by impact linkage; impact linkage supported at one end with fusible link that parts at 160 F and releases spring loaded valve arm; sudden blows that might break piping also release linkage and close valve.

White Print Machine . . .

. . . for reproducing blueprints and diagrams — *Reproduction Engineering Corp., 409 Main St., Ivoryton, Conn.*

Operates on standard a-c current; can reproduce up to 4 ft per min of single or multiple copies of blue or black line prints of anything drawn, typed, written or printed; equipped with external clutch and variable speed lever.



Solenoid Valve . . .

. . . for steam, hot gases, and light fluids up to 350 F—*Automatic Switch Co., Hanover Rd., Florham Park, N. J.*

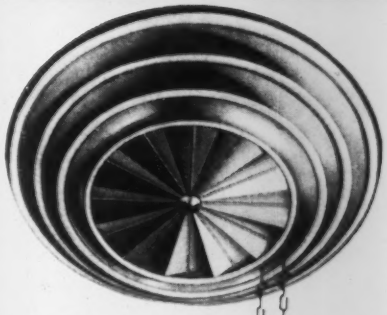
In pipe sizes of ⅜, ½, ¾ in. having full pipe area orifices; internally pilot operated with forged brass bodies and bonnets; may be mounted in any position.

Bypass Valve . . .

. . . for use on year 'round hydronic heating and cooling systems—*Econo Products Co., Div. of Viking Instruments, Inc., East Haddam, Conn.*

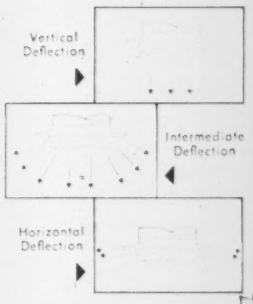
Designed for use on systems operating at pressures up to 250 psi;

Fresh air at working level improves employee efficiency



Barber-Colman industrial Venturi-Flo diffuser permits air to be introduced at the worker's level — duct work can be extended to provide a 10' mounting height. This prevents stagnant, smoky air, which has collected near the roof, from being mixed with the incoming fresh air. Employee comfort and efficiency are improved considerably.

The Venturi-Flo industrial diffuser can be adjusted easily from the floor to deliver any air pattern. In warm weather, the air should be delivered close to, or even directly at, the worker; while during cool evenings, or



in cold weather, the air should be diffused above the head of the worker, providing ventilation without drafts.

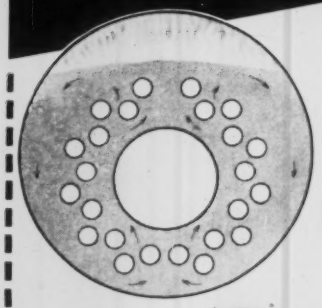
A complete range of sizes available to meet any industrial requirement. Ask for Bulletin F-7722-1. Call your Barber-Colman Field Office or write:

BARBER COLMAN

BARBER-COLMAN COMPANY

Dept. V, 1101 Rock Street, Rockford, Illinois

rapid, natural water circulation



2-PASS DESIGN...

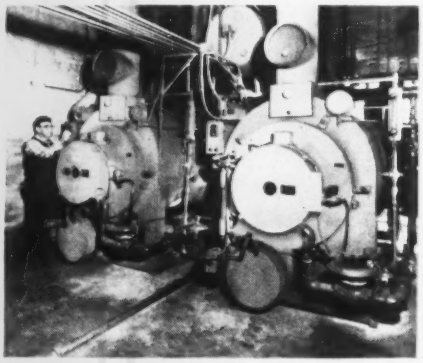
Continental
AUTOMATIC BOILERS

One of the important advantages of the *Continental* 2-Pass design is the large diameter combustion tube providing maximum heat release volume, surrounded by concentric location of tubes in the water circulation path to eliminate accumulation of any insulating gas pockets. Large clearances are provided between tubes and combustion chambers as well as between tubes and outer shell. This assures unimpeded rapid water circulation down around the shell and up around the furnace.

Other *Continental* features make this 2-Pass Automatic Boiler the one boiler with the most practical and economical approach to heat transfer of all packaged boilers today... Write today on your company letterhead for latest data designed to show how you can save with a *Continental*.

NEW CONTINENTALS– NEW SAVINGS

Two new 90 hp. *Continental* 2-Pass Automatic Boilers installed in industrial plant for economy in heating, reduced maintenance costs.



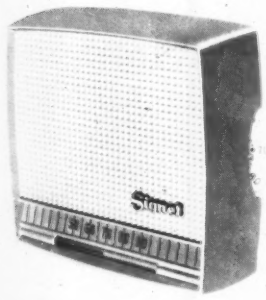
CONTINENTAL BOILER Division
BOILER ENGINEERING & SUPPLY CO., Inc.
Phoenixville, Pennsylvania

EQUIPMENT DEVELOPMENTS
Continued

Electrode Holder . . .

. . . for use with tungsten-inert-gas welding — *Air Reduction Sales Co., Dept. HPAC, 150 E. 42nd St., New York 17.*

Features completely enclosed water cooling system; transparent plastic tubing on hose assemblies; plastic holder body withstands temperatures up to 500 F; rated at 350 amps d-c straight polarity, 300 amps a-c; has minimum of $2\frac{7}{8}$ in. interference dimension.



Room Thermostat . . .

. . . with emphasis on appearance — *Signet Controls, 3205 S. E. 13th Ave., Portland 2, Ore.*

Has contacts made of platinum-iridium which will not corrode or oxidate; adjusting dial made of plastic that glows in dark; in 45 to 85 F range; thermostat is $3\frac{1}{8}$ in. high, $3\frac{1}{8}$ in. wide, $1\frac{7}{16}$ in. thick. Pamphlet on thermostat available on request.

Cupro-Nickel Tube . . .

. . . for high temperature feedwater heaters — *Chase Brass & Copper Co., 236 Grand St., Waterbury 20, Conn.*

this **WALKER** SHUR-FLO Draft Inducer-Regulator Unit...

ENDS DRAFT PROBLEMS RIGHT FROM THE START...

MODELS For Gas... Oil... and Solid Fuels!

"I don't fuss and fret with uncertain draft anymore since Walker brought out this low-priced draft inducer-regulator combination. Now, I install Walker inducers on all my jobs. That puts me way out ahead, because with good draft I know every job will be exactly right from the start."

THE INSIDE STORY OF SHUR-FLO EFFICIENCY

- Hi Volume Self-Feathering Fan
- Self-Cleaning Blades (No soot build-up)
- Stainless Steel Shaft, Hub, and Blades
- Quiet, burn-out proof motor
- Silicone oiled Bearings
- Extra heavy gauge galvanized steel construction
- Extra rigid mountings.

"Most Efficient Draft System Ever Made"

Say Heating Contractors, Architects, Home Owners

Draft problems end with Walker Shur-Flo (Pats. Pend.), SUREST DRAFT SYSTEM EVER DEVISED for oil, coal or gas-fired installations from older homes to modern, low-roofed houses. Install it, forget it! What could be better?

Fan-operated draft-inducer draws *only* flue gases —*not* outside air. Quiet. Costs less to operate. Needs little power. Installs quickly at *any* angle. Virtually eliminates costly call-backs, corrections.

For full details, see your supplier or write direct

WALKER MFG. AND SALES CORP.

1720 Penn Street St. Joseph, Missouri

Free!

"HOW TO CURE SICK CHIMNEYS"

Now, the *first* ready-reference guide collecting *all* the information on Power Inducer Venting you'll need to solve your draft problems. You'll find it indispensable. Get your handy copy *now!* Absolutely no obligation.

WRITE TO US AT ADDRESS AT LEFT

Scientifically Designed Walker Draft Controls for Every Draft Purpose Are Standards of the Industry. 30,000,000 in Use Prove Efficiency.

ROYAL PURPLE
for smaller central heating plants

BALANCED 34
for larger, special central heating

JUNIOR LINE
central heating budget control

TYPE BB
commercial and industrial control

DOUBLE SWING
for gas fired equipment

VENTURI CAP
for heating and ventilating

Remington Stud Driver

Loads in seconds . . . sets up to 9 studs a minute in concrete or steel

Here's the most efficient powder-actuated fastening tool ever designed. It's the new Remington Stud Driver with an *exclusive* combination of features that make it your best buy.

Built for speed, it has fast, easy drop-in loading. With Remington "Power-Guide" studs, no ramrod pushing of stud is necessary. Quick, positive ejection is another timesaver. A flip of the wrist and the fired cartridge pops out. With other tools the chamber bushing must be removed by hand, which is clumsy and slow. And only the Remington Stud Driver can be converted to one- or two-hand operation. No other tool has this feature.

Other advantages: Easy, fan-type opening and closing of tool and instantly interchangeable guards for greater versatility, efficiency.

Send coupon for special booklet that proves why the Stud Driver is the fastest powder-actuated tool—and best for you.

CHOOSE THE POWER MOST EFFICIENT FOR YOU. REMINGTON POWER TOOLS ARE AVAILABLE IN
AIR • ELECTRIC • GASOLINE AND POWDER-ACTUATED MODELS

Remington

DUPONT

Remington Arms Company, Inc., Bridgeport 2, Conn.
IN CANADA: Remington Arms of Canada, Limited,
36 Queen Elizabeth Blvd., Toronto 18, Ont.

G-10
FREE POWER TOOL CATALOGS
Remington Arms Company, Inc., Bridgeport 2, Conn.
Please send—without obligation—catalogs on Remington Contractor & Industrial Tools checked below:
☐ Stud Drivers ☐ Air Tools ☐ Chain Saws
☐ Concrete Vibrators ☐ Electric Tools ☐ Flexible Shaft Machines
Name _____ Position _____
Company _____
Address _____
City _____ Zone ___ State _____

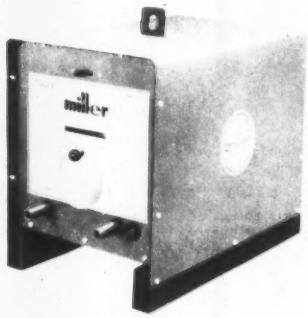
EQUIPMENT DEVELOPMENTS
Continued

Provides minimum of 72,000-psi tensile strength and 15 percent elongation for 1 in. OD X0.049 in. wall tube; ductility permits U-bend radius to OD ratios of 1.8.

Pipe Hanger . . .

. . . for pipe sizes from ½ to 8 in. "*Automatic*" *Sprinkler Corp. of America, Youngstown 1, O.*

Design consists of hinged metal band and captive locking insert for attachment to adjustable threaded hanger rod; insert is self-locking by spring action reinforced by weight of pipe and allows ring to pivot through 2½ in. from vertical to relieve expansion pressure on hanger rod.

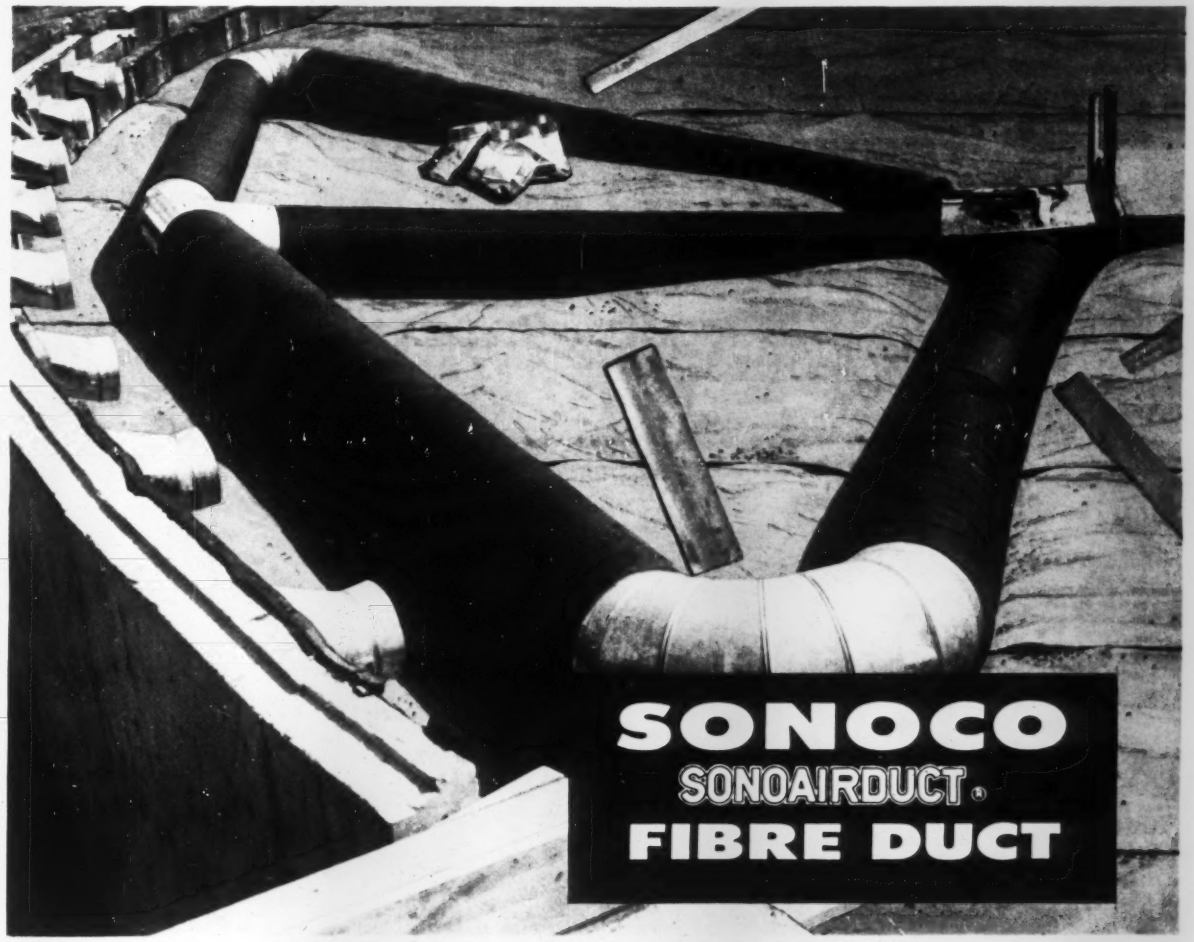


Welding Machine . . .

. . . filling gap between very small and very large welders—*Miller Electric Mfg. Co., Inc., 718 S. Bounds St., Appleton, Wis.*

Features 40 v. 60 percent duty cycle at 200 amps in two ranges of from 25 to 115 and 80 to 295 amps; 25¼ in., overall height; wired for either 230 or 460 v; also available with special voltages and complete accessory package.

Reduce Duct Installation Costs with —



12" and 20" Sonoairduct installed in new cafeteria; Taylor University, Upland, Ind.; Oris Eash, Fort Wayne, Ind.—Architect.

America's best selling Fibre Duct!

Sonoco SONOAIRDUCT is the original fibre duct and by far the most popular and most dependable. It is made especially for gas and oil fired slab perimeter heating or combination heating and cooling systems. Time, labor and money can be saved because the long lengths are easy to handle and level fast. There are no sharp, cutting edges—won't chip, crack or break when dropped.

SONOAIRDUCT meets and exceeds F.H.A. criteria and test requirements for products in this category. Available in 23 sizes—2" to 36" I.D., in standard shipping lengths of 18'. Special sizes, to order. Can be cut to exact lengths with an ordinary hand saw. Free installation manual sent on request.

See our catalog in Sweet's.

For complete information and prices, write—

SONOCO

Construction Products

SONOCO PRODUCTS COMPANY

552

- Hartsville, S. C.
- La Puente, Cal.
- Fremont, Cal.
- Montclair, N. J.
- Akron, Indiana
- Longview, Texas
- Atlanta, Ga.
- Brantford, Ont.
- Mexico, D. F.

DARTS ARE THRIFTY ON THE POCKETBOOK

. . . TIGHT ON THE LINE!

Yes sir, Dart Unions cut costs because

1. They last longer — their two bronze seats are precision ground to a true ball joint.
2. They're easy and fast to install.
3. They *stay* tight — damage no property, spoil no work.
4. They can be used over and over again.

Which is why the answer to "How thrifty, how tight *can you get* is . . . GET DARTS"!

QUICK FACTS

- Leakproof because precision-machined to a true ball joint and spherically ground
- Shoulders are heavy — can take abuse
- Each Dart is individually vacuum-tested
- Bronze alloy seats are extra wide, resist pitting and corrosion
- Practically indestructible nut and body — of air-refined, high-test malleable iron

DART UNIONS *Products of* DART UNION COMPANY PROVIDENCE 5, R.I.

GENERAL SALES AGENT

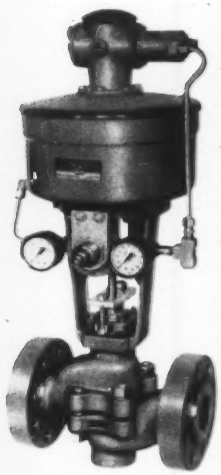
THE **Fairbanks** COMPANY
393 LAFAYETTE STREET, NEW YORK 3, NEW YORK
BRANCHES: NEW YORK 3
PITTSBURGH 22 • BOSTON 10 • ROME, GEORGIA

AVAILABLE THROUGH YOUR LOCAL DISTRIBUTOR

EQUIPMENT DEVELOPMENTS

Continued

automatically controls heating or cooling as called for by corresponding thermostat.



Control Valves . . .

. . . available with ductile iron body — *Conoflow Corp., Dept. D-8, 21 Arch St., Philadelphia 3, Pa.*

Straight-through design in $\frac{3}{4}$ to 6 in. for pressures from 150 to 300 psi; raised face integral flanges; available with screwed connections up to 2 in.; also available in steel, bronze; data sheet "D-1-59" available on request.

Equipment Briefs . . .

PORTABLE NIBBLERS that operate on punch and die action — *Fenway Machine Co., 3107 N. Broad St., Philadelphia 32, Pa.* Capable of cutting up to 10 gage stainless or 8 gage mild without distortion; cuts copper, brass, aluminum; 5 ft cut per min; weighs 8-13 lb.

INSULATION ADHESIVE for bonding blanket type insulation material to ducts — *Capac Mfg. Corp., P.O. Box 186, Capac, Mich.* According to manufacturer, eliminates need for bands or wires. Adhesive speeds application of insulation to heating and air conditioning ductwork, says company.

NOW...for underground fuel oil storage tanks—
a tank suction heater with easily accessible service connections

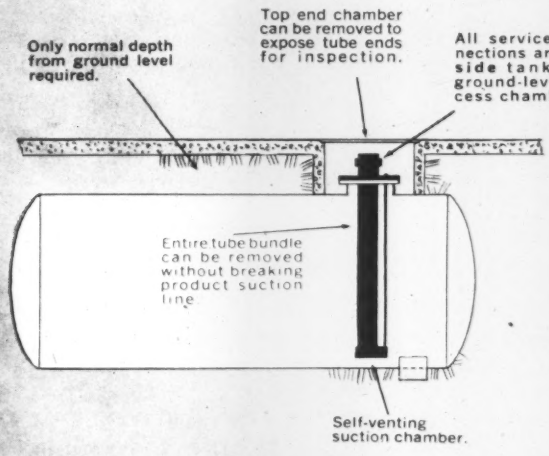
PARACOIL "VUF"

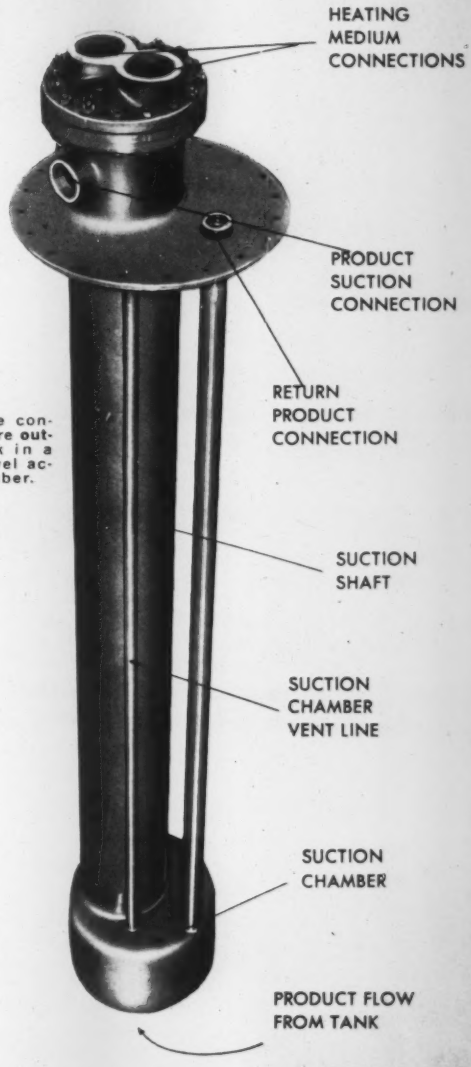
VERTICAL TANK SUCTION HEATER

Designed to simplify both installation and service. Heater is suspended from tank manhole flange. **All connections are outside the tank.** A new Paracoil invention.

Uses hot circulated fluids as heating mediums — insuring positive suction temperatures.

The simplest method of preheating fuel oils and other viscous liquids in underground storage tanks.


Only normal depth from ground level required.
Top end chamber can be removed to expose tube ends for inspection.
All service connections are outside tank in a ground-level access chamber.
Entire tube bundle can be removed without breaking product suction line.
Self-venting suction chamber.



Hot return product mixes with fresh product in suction chamber, providing an initial temperature rise even before the heating tubes are reached.

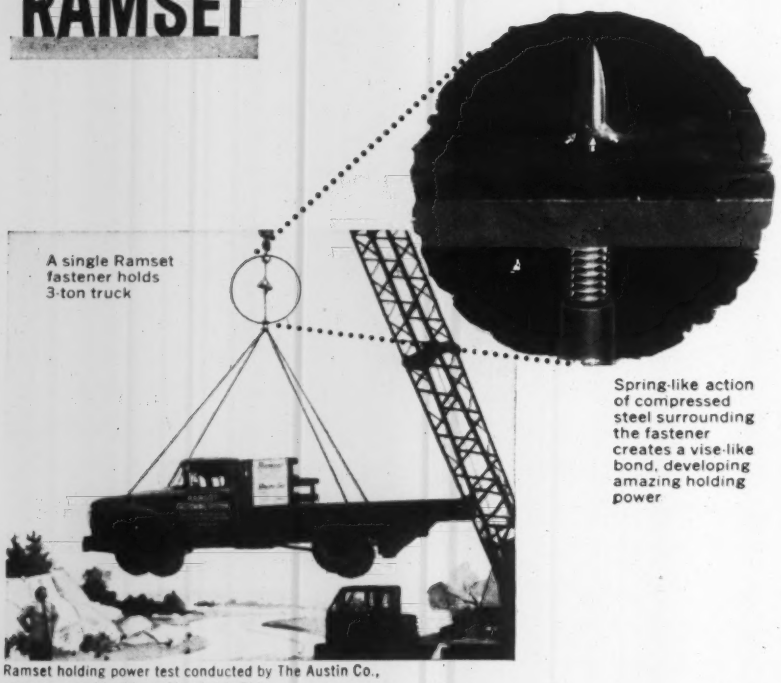
Available in standard sizes and capacities for various product fluids.

A Product of

DAVIS ENGINEERING (A Division of American Metal Products Company)

520 Main Avenue, Wallington, N. J.

ONLY RAMSET


A single Ramset fastener holds 3-ton truck
Spring-like action of compressed steel surrounding the fastener creates a vise-like bond, developing amazing holding power

Ramset holding power test conducted by The Austin Co., engineers and builders, Cleveland, Ohio

offers austempered fasteners with such superior holding power

Even under the most demanding workloads, Ramset's austempered Red-Tip fasteners assure more holding power and greater fastener strength. Austempering, Ramset's high-heat slow-quench treatment, puts extra strength, toughness and dependability into every Ramset Red-Tip fastener.

Ramset's wide variety of fastener sizes puts the *right* fastener on each job—you don't have to "make-do" with off-size pins or studs. Ramset assures positive, guaranteed fastenings into tough steel, concrete or masonry faster and easier, and at lower in-place cost. Consider Ramset's many advantages and the "100-for-100" guarantee—call your Ramset dealer (under "Tools" in Yellow Pages) for details.

In addition to powder-actuated fastening, the versatile Ramset System includes Shure-Set® hammer-in tools for light fastening, and Ringblaster® heavy-duty kiln gun.

Ramset Fastening System

WINCHESTER-WESTERN DIVISION • OLIN MATHIESON CHEMICAL CORPORATION
291-J WINCHESTER AVE. • NEW HAVEN 4, CONNECTICUT

EQUIPMENT DEVELOPMENTS

Continued

OIL BURNER FILTER that can be interchanged easily with any one of 24 leading filter elements — *Purolator Products, Inc., 970 New Brunswick Ave., Rahway, N.J.* All filter elements supplied with adapter rings and extensions; manufacturer offers cross-reference chart that identifies 4 new filter refills and 7 commercial filter models; charts designated "IND-10."

PNEUMATIC SWITCH mechanism in vapor-proof and explosion-proof switch housing—*Magnetrol, Inc., 2110 S. Marshall Blvd., Chicago 23.* Uses air or gas as operating pressure medium; head can be set up so that either electric or pneumatic action can be secured.

PIPE WRENCH forged wholly from aluminum bar stock — *Schick Products, Inc., P. O. Box 867, Belmont, Calif.* Available in 10, 14, 18, 24, 36, 48 in. long sizes with jaw capacities of 1½, 2, 2½, 3, 4½, 6 in.; models have insert steel jaws which are replaceable.

MASS FLOW METER which measures liquid and gas flow directly in pounds—*General Electric Co., Schenectady 5, N.Y.*

TRANSMITTING POTENTIOMETER that converts low level direct current electrical signals to proportional 1.0 to 5.0 milliamper direct current signals for transmission to distant measurement and control systems—*Manning, Maxwell & Moore, Inc., 250 E. Main St., Stratford, Conn.* Standard ranges are 0-200 F with iron-constantan thermocouples, 800-1100 F; 300-2000 F to 700-1100 F with chrome-alumel thermocouples.

VIBRATION ABSORBER composed of elastomeric vinyl plastic—*Lowell Industries, Inc., Boston 34.*

Not 20 to 30 minutes—

but

Just 7 seconds to insulate this bend!

New Johns-Manville AEROTUBE insulation cuts labor costs 50%...and more!

New Aerotube® Insulation entirely eliminates twine wrapping, skirting and other time-consuming methods of insulating lines that sweat!

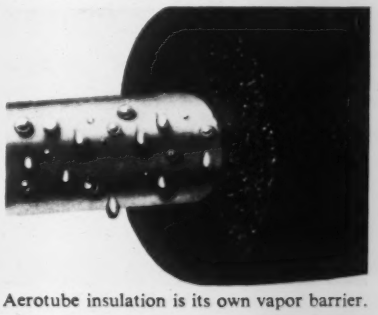
On a straight run of pipe or the most complex bend—Aerotube goes on fast! Just slides on new lines . . . six feet at a time . . . in a matter of seconds! On connected pipe, the job takes but little longer. Just the time it takes to slit Aerotube longitudinally, snap on pipe, and cement.

With all its savings in time, Aerotube gives you better results! Its unique closed-cell structure helps seal against heat transfer . . . gives Aerotube a built-in vapor barrier that retains its integrity indefinitely.

Use Aerotube wherever an effective vapor-sealed insulation is needed—air conditioning run-outs, CO_2 lines, dual temperature systems, on any line (to 200F) where Aerotube's labor savings will repay its slight additional cost many times over!

Send for informative new AEROTUBE brochure, IN-213A. It illustrates methods of fitting AEROTUBE to all types of fittings . . . sweat and screw type joints . . . and connected pipe. Gives best thicknesses for various design conditions, with helpful facts on sizes, packaging data and dimensions. *Write for your free copy now!* Address Johns-Manville, Box 14, N.Y. 16, N.Y. In Canada, Port Credit, Ont.

Flexible new foamed plastic insulation



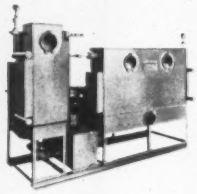
Aerotube insulation is its own vapor barrier.

JOHNS-MANVILLE

JOHNS MANVILLE JM PRODUCTS

KATHABAR® SYSTEMS

Give these advantages to specifying engineers:



STERILE AIR

Now you can design spaces to maintain air sterility as scientifically as temperature and humidity. Only Kathabar enables you to deliver air at 5 micro-organisms per 10 cu. ft. or less, continuously.

PRECISE DESIGN

Reduce dew point of air from 72 F to 46 F with 85 F water! No over-cool & re-heat costs. Kathabar lets refrigeration handle sensible cooling only (sensible, economical). Deliver consistent gr./lb. and DB for process, storage, testing in foods...concrete... chemicals...paper... printing...rocket fuels... "clean" rooms...everywhere.

GET FACTS

SURFACE COMBUSTION CORPORATION

2384 Dorr Street, Toledo 1, Ohio

Send facts on Kathabar systems for following application:

.....

.....

name & title .....

company .....

street .....

city ..... *zone* ..... *state* .....

59-3E

EQUIPMENT DEVELOPMENTS

Continued

Mass. Suitable for machines from 100 lb to 100 tons; has breaking strength of 7500 psi.

ROOM AIR CONDITIONERS designed especially for seaside areas where saltwater spray and most salt air are corrosive—*Frigidaire Div., General Motors Corp., Dayton* 1, O. Models have cooling capacity of 10,100 Btu; one model also has heating capacity of 8700 Btu; both units have 2-speed fans, air directional controls and provision for fresh air intake and room air exhaust.

WELDING RODS suitable for work where only small amount of flux is needed to prepare and clean weld—*Air Reduction Sales Co., Div. of Air Reduction Co., Inc.*, 150 *E. 42nd St., New York* 17. Available in 3/32, 1/8, 3/16, and 1/4 diam.

HOSE CLAMPS can be installed where applications as small as 3/8 in. in diam are desired—*Ideal Corp.*, 135 *Liberty Ave., Brooklyn* 7, *N.Y.*

TRUCK MOUNTED CRANE that doubles use of flatbed or dump truck—*Foecuil Corp.*, 79 *W. Monroe St., Chicago.* Mounts in 13 in. space between cab and truck bed; telescopes and folds out of way when not in use; lifts up to 2.2 tons; lifting height to 21 ft with boom fully extended to 15 ft 2 in.; swing angle 270 deg; weight 1200 lb.

TIME-CYCLE CONTROLLER for such applications as operation of tire presses, dyeing, water condition, batch processes—*Bristol Co., Waterbury* 20, *Conn.* Ten pilots — pneumatic, electric, or combination; each pilot can perform up to 24 operations; timing discs range from 15 min to 360 min; bulletin "C-311" describing instrument available on request.

MSA reports on:

How to Select an Air Cleaner

MSA reviews here some of the factors which influence selection of air cleaners. A speaking acquaintance with these factors can save a lot of time and money. If you would like to dwell further on any of these points, please drop us a line. We believe we can be of great help in answering questions on your specific air cleaning problems.

CLASSIFICATION OF PARTICULATE LOADS—Let's draw a parallel. Because of the heavy dust load in a sand blast booth, you would have to select a sand blast mask instead of a dust respirator. Selection of a particulate space filter is much the same proposition. You must determine the quantitative nature of the particulate load.

For this purpose, let's briefly classify particulate loads. A light load is 0.1 to 1 grain per 1000 cu. ft. A medium load is 1 to 1000 grains per 1000 cu. ft. A heavy load is 1000 grains and up per 1000 cu. ft.

One grain per 1000 cu. ft. = 2.3 mg per cubic meter = 2.3 micrograms per liter. One milligram is equivalent to 0.015432 grains. As a comparison, the concentration of the U. S. Bureau of Mines silica dust test is approximately 22 grains per 1000 cu. ft. of air.

CLASSIFICATION OF NORMAL LOAD RANGES—Country air usually registers 0.2 grains 1000 CF. Small town air ranges from 0.2 to 0.4 grains 1000 CF. City residential air ranges from 0.4 to 0.8 grains/1000 CF. City industrial air ranges from 1.0 to 2.0 grains/1000 CF. And air from industrial operations weighs in at 4.0 to 8.0 grains/1000 CF. 7000 grains, incidentally, is equal to 1 lb.

CLASSIFICATION OF PARTICULATE CLEANERS—Your actual load condition will determine which group of particulate cleaners is of immediate interest to you.

For the heavy loads: gravity separators, cyclone separators and sonic collectors.

For the medium loads: all of the above plus bag filters, impingement type box filters, and wet collectors.

For the light loads: box filters of both types and, in addition, electrostatic precipitators.

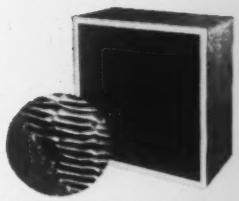
Of course, if you require ultra filtration on heavy load conditions, you should use M-S-A® UltraAire* Space Filters after the heavy duty filters.

PHYSICAL CHARACTERISTICS OF THE PARTICULATES—These characteristics affect the choice of filtering methods and/or design of the filtering system: Particle size, particle shape, specific gravity of particles, particle surface characteristics, packing or plugging characteristics, electrostatic charge on the particle, stability of the particle.

PHYSICAL CHARACTERISTICS OF THE AIR STREAM—These factors too, are worthy of investigation: Density of air, moisture in air stream, temperature of air stream, chemical and physical effect of gaseous contaminants.

DEGREE OF FILTERING OR CLEANLINESS REQUIRED—We'd like to suggest here, that you give some thought to the toxicity or harmfulness of the particulate matter. Evaluate too, the need for cleanliness, product control, equipment maintenance, etc.

ECONOMIC FACTORS—Factors to weigh under this heading are installation costs, space requirements and operating and maintenance costs (including cost of moving air through system, replacement, etc.).

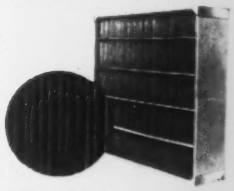


M-S-A® UltraAire* Space Filter

Lightweight, fire-resistant, unusually strong, and ideal for high humidity service. Individually pre-tested and proved at least 99.97% efficient in removing particles of 0.3 micron diameter.

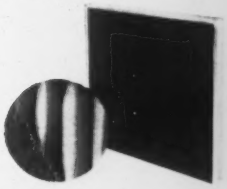
M-S-A® Cylindrical-Type UltraAire* Space Filter

Honeycomb-type fold without separators is admirably suited to cylindrical element construction. This shape is preferred for pressure systems and round ducts. Easy to handle. Inexpensive to ship.



M-S-A® Dustfoe* Space Filter

Offers the efficiency of an Electrostatic Precipitator without the high cost and without the possibility of arcing "blow-off." 85-95% certified efficiency on NBS Atmospheric Air Dust Stain Rating.



M-S-A® Air-O-Kay* PreFilter

Impingement type panel prefilter which can be used oiled or dry to remove lint and other large airborne particles from the atmosphere. 60-70% certified efficiency on NBS Stain Rating.

Write for illustrated technical bulletins on M-S-A Space Filters related to your particular system problem. Ask an MSA Representative for system recommendations.

Fluid Purification Specialists for 45 Years

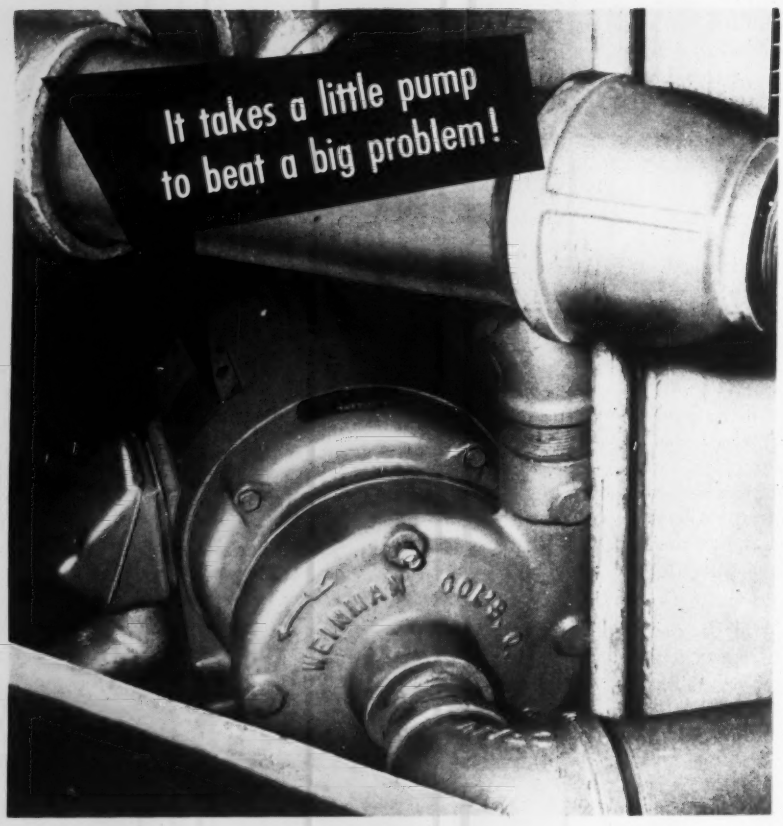
MINE SAFETY APPLIANCES COMPANY

201 North Braddock Avenue, Pittsburgh 8, Pa.

MSA*

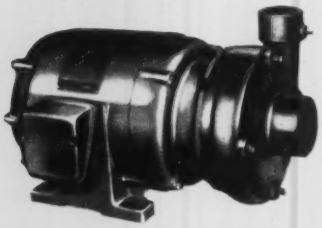
*Trademark

Other Fluid Purification Equipment includes catalytic filters for jet aircraft cabin air; air separation plants; inert gas generators; space capsules; bomb shelters; air line filters; jet fuel and hydraulic fluid purification.



Compact WEINMAN AC pumps simplify installation of air conditioning systems

Lack of space can be a real problem in air conditioning installations. The best way to lick this difficulty is with Weinman AC air conditioning pumps. These compact, versatile units take up little space, can be mounted in any position and yet operate year after year without failure. One reason — ceramic floating seal seat and synthetic carbon compound sealing washer assure long trouble-free service, leakless operation, even when handling water carrying abrasive dust.



There are over 60 models to choose from. Output ratings up to 260 g.p.m., heads up to 150', horsepower ratings from ¼ to 7½. See your Weinman centrifugal pump specialist. He's listed in the Yellow Pages. Or, write us direct.

50th Anniversary 1909 1959

THE WEINMAN PUMP MFG. CO.

290 SPRUCE ST. COLUMBUS 8, OHIO

CENTRIFUGAL SPECIALISTS

RECENT TRADE LITERATURE

▸ *AIR COMPRESSORS*—service manual containing over 400 pages of parts lists, information on installation, operation, and maintenance; manual is $2.50 f.o.b. Toledo; $2.80 f.o.b. west coast shipping points. *DeVilbiss Co., Toledo 1, O.*

▸ *AIR DEHUMIDIFIER*—for industrial processing and product drying featured in new bulletin "140" including operating description and dehumidifying capacities. *Niagara Blower Co., 405 Lexington Ave., New York 17.*

▸ *AIR DIFFUSERS*—details presented in new booklet "649" describing design features and characteristics of diffusers used in various applications. *Pyle-National Co., 1334 N. Kostner Ave., Chicago 51.*

▸ *AIR MOVEMENT*—information in catalog-folder gives specifications, dimensional data, velocity graphs, and features of roof ventilator; illustrations show how units are tested and rated. *Greenheck Fan & Ventilator Corp., Schofield, Wis.*

▸ *ALUMINUM SHEETS* and other materials made from aluminum are discussed in new illustrated brochure which describes aluminum production and many of its uses. *Anaconda Co., 25 Broadway, New York 4.*

▸ *BALL BEARINGS*—of double row type are described in bulletin "111" including dimensions and load specifications for light and medium series and applications for each. *Hoover Ball & Bearing Co., 5400 South State Rd., Ann Arbor, Mich.*

▸ *BOILER BLOWOFF*—manual "4700-A" shows possible savings through use of continuous blowoff systems; includes reference charts for estimating savings, types of installations for various plant require-

For the first time!

Everything you need in Dial Thermometers for Piping *and* Duct work!

A new and complete line of instruments: Dial thermometer of Marsh precision and accuracy designed down to the last detail for piping and duct work . . . for use on heating and cooling equipment, air ducts, vessels and kilns, ovens and similar applications.

Easier to read

Illustrations tell the story. Four types, seven ranges—72 stock combinations to meet every condition. Big, legible 3½" and 4½" dials . . . easy to read in places where piping and duct thermometers must be installed. Ease of reading further increased by provision for tilting and turning dials to any desired reading angle. Line includes distant reading types that take care of remote locations.

Unbreakable—more accurate

Instead of fragile difficult-to-read glass tube thermometers you now have sturdy, unbreakable, legible Marsh Dial Thermometers. Guaranteed accurate to plus or minus one division of the scale, they have far greater *readable* accuracy than any glass tube type. All have the famous Marsh "Recalibrator"—to *keep* them accurate.

All purpose

Design provides for every on-the-job condition. Separable sockets ("wells") simplify installation—or removal for servicing. Extension necks take care of insulation on piping or ducts. Long stems in duct type put temperature-sensitive section where it belongs.

Note the brief specifications opposite. Any thermometer is available from stock.

Write for bulletin telling the whole story.

Marsh Instrument Company
Division of Colorado Oil and Gas Corporation
Dept. T, Skokie, Ill.
Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta

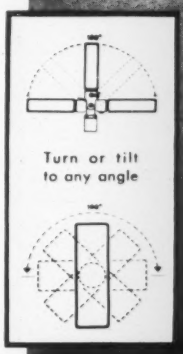
For piping

Dial sizes: 3½" and 4½"

Ranges:
0° to 100°F for chilled water
20° to 120°F for condenser water
40° to 240°F and 100° to 300° for hot water and domestic water

¾" NPT connection

All ranges, in both direct mounted and remote reading types, available with three standard sockets shown in drawing below.



For ducts

Dial sizes: 3½" and 4½"

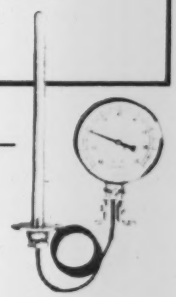
Ranges: −40° to +120°F
0° to 160°F
0° to 220°F

All ranges, in both direct mounted and remote reading types, available with standard extension necks and stems shown in drawing below.

MARSH
DIAL THERMOMETERS

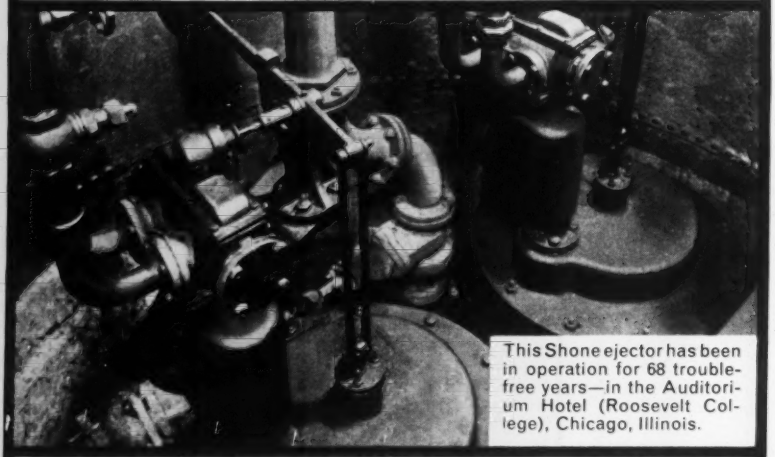
Also remote reading—

Piping and duct thermometers of same basic design available with 6 ft. of capillary tubing as shown.



See us at Booth 201 Atlantic City Nov. 2-3-4-5

for pumping domestic and industrial wastes...



This Shone ejector has been in operation for 68 trouble-free years—in the Auditorium Hotel (Roosevelt College), Chicago, Illinois.

YEOMANS pneumatic ejectors cut service costs because

THERE'S NOTHING TO WEAR OUT

- NO ROTATING PUMP PARTS
- NO AIRTIGHT FLOATS
- NO HIGH-SPEED SHAFTS OR BEARINGS

With Yeomans pneumatic ejectors, maintenance costs are 50% to 75% lower than with the best centrifugal pumps. The secret? Simplicity of design. Yeomans pneumatic ejectors are built to give you decades of trouble-free service—in fact, they will outlast your system.

They're recommended for low gallonages. Even the smallest Yeomans ejector will pass solids up to the size of the inlet and discharge valves . . . minimum of four inches. No danger of clogging.

They're safer, and completely sanitary. Fully enclosed, hermetically sealed. Dangerous hydrogen sulphide gas is never released.

Yeomans manufactures both centrifugal pumps and pneumatic ejectors, but recommends the ejector where extreme dependability is required. Among the seven models and more than 100 sizes there is a pneumatic ejector that will exactly fill your needs.

Manufacturers of: pumps for drainage • sewage • condensation return • water supply and circulation • equipment for treatment of domestic and industrial wastes.

YEOMANS

YEOMANS, 2000-5 N. Ruby Street, Melrose Park, Illinois

Please send me literature on the pneumatic ejectors I have checked.

The Shone ☐

The Packex ☐

The Expelsor ☐

name_____

company_____

street_____

city_____ zone_____ state_____

E-5907

RECENT TRADE LITERATURE

Continued

ments. *Cochrane Corp., 17th St., below Allegheny Ave., Philadelphia 32, Pa.*

▸ *BOILER HEAT TRANSFER* bulletin "4" discusses advantages of immersion firing and includes review of earlier bulletin materials. *Sellers Engineering Co., 1876 N. Clark St., Chicago 40.*

▸ *BOILER WATER TREATMENT*—methods described in bulletin "I-171" include methods of external and internal application; gives chemical, physical descriptions of product which control scale formation on boilers. *Inorganic Chemicals Div., Monsanto Chemical Co., 800 N. Lindbergh Blvd., St. Louis 66, Mo.*

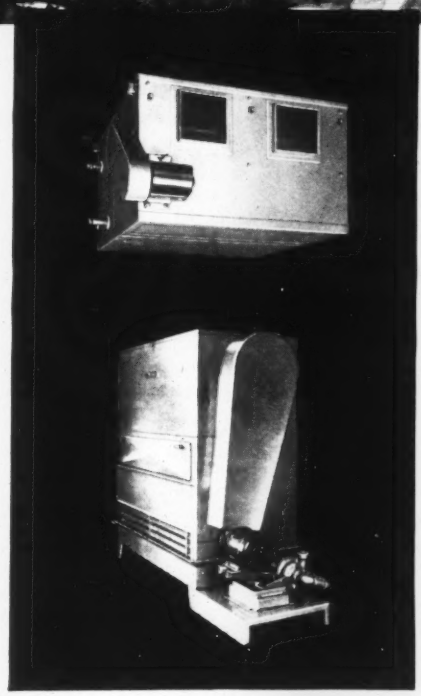
▸ *BRONZE VALVES*—advantages discussed in pamphlet presenting features of valve and listing service representatives. *Walworth Co., 750 Third Ave., New York 17.*

▸ *BTU METERING* in new brochure describing large installation of Btu meters for billing heating and cooling charges from central system in large shopping centers; details installation, operation, and maintenance. *Air Conditioning Equipment Corp., 219 E. 44th St., New York.*

▸ *CENTRIFUGAL PUMPS* with capacities up to 320 gpm and pressures to 40 psi described in bulletin "1001" containing design features, uses of pumps, performance data on clockwise, counter-clockwise and reversible pumps, and specifications for all models. *Marine Products Co., 515 Lycaste, Detroit 11, Mich.*

▸ *COMBUSTION CONTROL* for heating described in bulletin "659." Data on installation, wiring, control, basic operation presented. *Protection Controls, Inc., 6000 N. Legett Ave., Chicago 46.*

HEYMANN'S OIL CENTER—Lafayette, Louisiana
Architect & Engineer: A. Hays Town, Baton Rouge
General Contractor: Horace B. Rickey, Lafayette
Mechanical Contractor: Butcher Air Conditioning Co., Lafayette



Marlo Air Conditioning keeps people running smoothly at this big oil community

This is Heymann's Oil Center, deep in the oil country of Louisiana. It's a concentrated base of operations for many petroleum, pipeline and drilling companies whose products keep America's machinery running smoothly, without breakdown. Office buildings, a bank, shopping center and motel are conveniently packaged in this unique community—the largest of its kind in the petroleum industry.

If machinery must be protected against heat, strain and friction, so must people—especially under flat roofs beneath a scorching southern sun. At Heymann's Oil Center, air conditioning by Marlo, including 26 Marlo cooling towers and five Marlo central station units, helps create a comfortable, refreshing atmosphere in every building . . . keeping minds alert and spirits unwilted.

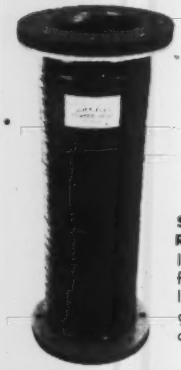
The Marlo representative in your area can give you complete information on the variety of air conditioning and heat transfer equipment in the Marlo line. Or, if your prefer, write direct to us.

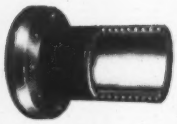
Marlo coil co.

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

a quiet answer to noisy piping...





Style RFE— Integral molded rubber flanges keep entire hose length flexible . . . eliminate gaskets. Steel backup rings distribute bolt pressure.

VM

QUIET-FLEX

REINFORCED FLEXIBLE RUBBER PIPE SECTIONS

Completely isolate pipe lines from pumps, centrifugal compressors, condensing units, water chillers and cooling towers. Quiet-Flex rubber pipe connections will withstand working pressures up to 250 psi . . . continuous operating temperatures up to 250°F.

Write for descriptive Bulletin RFP-10 and Vibration Engineering Data Book.

If it's a noise or vibration problem, get the right answer — quick — from Representatives in Principal Cities of United States and Canada

Style MM— Brass fitted couplings with male pipe threads provide leak-proof connection with uniform full flow area. Stock sizes—¾" through 4" diameter in lengths 12" through 36".

VIBRATION MOUNTINGS, INC.

98-11 50th Avenue • Corona 68, New York

FREE – The Full Story Of Economical Infra-Red Comfort Heating

OVERHEAD PANELBLOC

Industrial and commercial buildings of all kinds are now being heated by economical gas-fired overhead PANELBLOCS – the unit that "Heats Like the Sun." Panelbloc offers an entirely new heating concept. Unlike traditional heating equipment that heats the air, Panelbloc heats objects and people.

Panelbloc is low in first cost, installation is economical, since no electrical connections are needed. No fans or motors are needed for these unique heaters.

We have a complete literature file on this equipment, and you are welcome to any items you'd like to have.

Gentlemen: Please send me literature checked:

☐ PANELBLOC CATALOG
This pictures and describes the equipment, gives dimensions and technical data on operating principles.

☐ PANELBLOC PHOTO ALBUM
This lavishly illustrated brochure shows actual installations in a wide range of commercial and industrial plants.

☐ PANELBLOC CASE HISTORIES
Tell us what your business is, and we'll send you a case history describing Panelbloc in a business similar to your own.

☐ TRADE PAPER REPRINTS
Learn what the experts say about Panelbloc.

JUST CLIP THIS SHEET TO YOUR LETTERHEAD AND MAIL TO US

PANELBLOC DIVISION
The Bettcher Mfg. Corp.
3106 West 61 St., Cleveland, Ohio

RECENT TRADE LITERATURE

Continued

▶ *COMBUSTION CONTROL*—bulletin "59-C091 (297)" describes systems which are coordinated with boiler room instrumentation including complete description and specifications for each product. *The Hays Corp., Michigan City 34, Ind.*

▶ *COMPRESSOR LOADER*—permitting constant evaporator temperature is described in bulletin "BL-5"; illustrates system with loader introduced. *W. Blazer & Son, 173 Market St., Passaic, N.J.*

▶ *COOLING CONTROLS*—catalog "1487-AK" lists line voltage and cooling thermostats which supplement several previously cataloged thermostats. *Penn Controls, Inc., Goshen, Ind.*

▶ *COOLING TOWERS*—featuring plastic horizontal deck described in catalog "362" which includes specifications, capacities, and dimensions. *Acme Industries, Inc., 600 Mechanic St., Jackson, Mich.*

▶ *COOLING TOWER*—bulletin describes performance standards; includes full capacity tables and suggested specifications for each component. *J. F. Pritchard & Co., of California, 4625 Roanoke Parkway, Kansas City 12, Mo.*

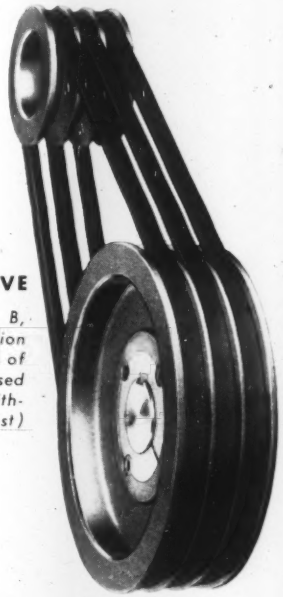
▶ *CO_2 WELDING*—booklet "EW-208" contains information on power sources, welding costs, desposition sitioning, electrodes, weld metal rates, welding preparation and positioning, electrodes, weld metal properties, test specimens, tables and charts. *Hobart Brothers Co., Troy, O.*

▶ *CRANE CAB AIR CONDITIONERS*—to increase work efficiency, morale, and safety are discussed in new bulletin; includes tables, charts

Announcing

an entirely new line of V-Belt Drives . . . . .

DODGE Dyna V



CONVENTIONAL TAPER-LOCK DRIVE

(— using standard A, B, C, D and E cross section belts, the hp ratings of which have been increased an average of 40% without any increase in cost)

DYNA-V TAPER-LOCK DRIVE

NEW HIGH CAPACITY

NEW COMPACTNESS

NEW SAVINGS IN COST

COMPARISON, ILLUSTRATED ABOVE — 3 HP, 1750 RPM, 2.41 TO 1 RATIO

	BELTS		SHEAVES			CENTER DISTANCE	HP	WEIGHT (LBS.)	COST	
	Number	Size	O.D. Driver	O.D. Driven	Width				Per hp	Per Drive
CONVENTIONAL TAPER-LOCK DRIVE	3	A42	4.15"	8.95"	2½"	12.3"	4.62	24.7	$5.62	$25.98
DYNA-V TAPER-LOCK DRIVE	2	3V400	3.35"	8.00"	1$^{3}/_{32}$"	10.8"	5.0	18.0	$4.50	$22.50
% SAVING *Savings vary with different sized drives*			**19%**	**10%**	**56%**	**12%**	+	**27%**	**19.9%**	**13.4%**

Dyna-V Drives are sensationally compact. They are capable of handling up to three times as much horsepower in a given space. Dyna-V opens vast new possibilities for better, more economical machine design. And, in most instances, *Dyna-V costs less!*

Narrower grooves, to match stronger, narrower Dyna-V Belts, greatly reduce the face width and the weight of Dyna-V Sheaves. Cost is lowered. Smaller diameter sheaves and shorter center distances multiply savings.

Dyna-V Sheaves decrease shaft overhang—increase bearing life. The new dimensional stability of Dyna-V Belts solves the problem of belt matching. Every belt carries its full share of the load.

Dyna-V Drives will be available for capacities from 1 to 1500 hp. Ask your Dodge Distributor. Or write us for new Dyna-V Bulletin.

DODGE MANUFACTURING CORPORATION, 1600 Union St., Mishawaka, Indiana

DODGE

of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide
Changes that Danger Zone to a
SAFETY ZONE

The distance between the floor of your plant and your overhead valves is a DANGER ZONE when piled up boxes or even ladders are used to reach the valves.

Turn it into a SAFETY ZONE — equip your overhead valves with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. If your supplier does not carry them, contact us direct.

Babbitt 168-9

STEAM SPECIALTY CO.

8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

RECENT TRADE LITERATURE

Continued

of temperature conditions in steel plants; describes types of air conditioners best suited for various kinds of crane cabs; second bulletin "1350-33" with types of models includes dimensions, motor and compressor data. *James Campbell Smith, Inc., Willoughby (Cleveland), O.*

▶ *DAMPER CONTROL*—for heating-cooling combinations presented in new manual; includes description of design, installation, and operation. *Morrison Products, Inc., 16816 Waterloo Rd., Cleveland 10, O.*

▶ *DIELECTRIC UNIONS*—catalog presents specifications and performance standards, diagrams, illustrations of various models and discussion of results of corrosive effect of connecting dissimilar metals directly. *Epco Sales, Inc., 3204 Sackett Ave., Cleveland 9, O.*

▶ *DUST COLLECTION*—information sheet includes illustrations, drawings, and specifications for dust control equipment. *Torit Mfg. Co., Dept. KP-3, Walnut & Exchange Sts., St. Paul, Minn.*

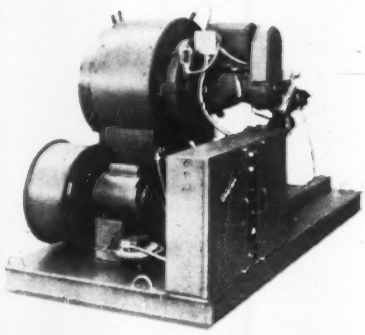
▶ *ELECTRIC-EYE*—wide range of applications in process industries described in illustrated bulletin "522." *Photomation, Inc., 96 S. Washington Ave., Bergenfield, N. J.*

▶ *EXPANSION JOINTS*—Suitable for service under full vacuum illustrated in new bulletin; gives information on flanges, liners, covers, temperature ratings, and other material. *Badger Mfg. Co., 230 Bent St., Cambridge 41, Mass.*

▶ *FAN-COIL UNITS*—used with duct connection in new data sheet "UCR-231 7-59" described with specifications for 300 cfm unit; data sheet also gives dimensions and capacities for various models. *Drayer-Hanson Div., National-U.S. Radiator*

Webster

GAS and/or OIL BURNERS



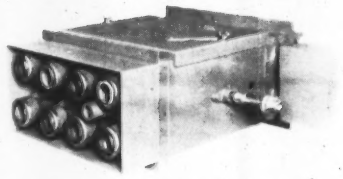
LARGE or SMALL

SINGLE or DUAL FUEL

PACKAGED or FIELD ASSEMBLED

ATMOSPHERIC or FORCED DRAFT

ELECTRONICS of ALL TYPES



COMPETENT
Sales and Service
in all areas

Write for Bulletin B1

The
WEBSTER ENGINEERING
Company
Box 5246, Tulsa, Oklahoma

Big warehouse keeps warm with four heaters

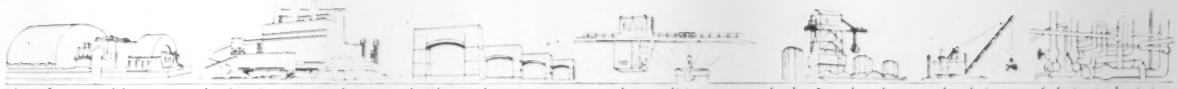
This 79,000 square foot warehouse of the C. A. Turner Company, Rankin, Pa., has high roof areas and large access doors. Yet, only four Dravo *Counterflo* heaters were needed to maintain a 68° comfort level during last January's severe cold spell with its frequent sub-zero temperatures. Fuel costs for the month were 7/10¢ per square foot!

More than 20,000 Dravo heaters, in use throughout the world, provide this same low cost heating in manufacturing plants, schools, commercial and public buildings. A factory-trained organization handles service on 24-hour call.

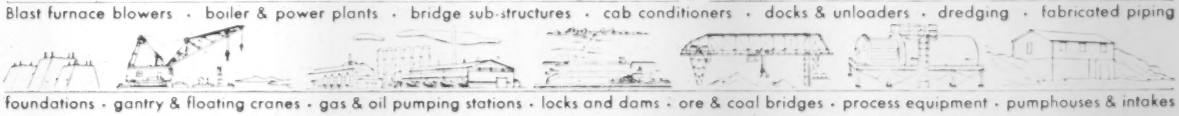
Are you paying for inadequate, obsolete or inefficient heating? A Dravo engineer will evaluate your present system now at no obligation. For information on this, or any of the other services and products pictured below, write DRAVO CORPORATION, PITTSBURGH 25, PENNSYLVANIA.

DRAVO

CORPORATION



Blast furnace blowers · boiler & power plants · bridge sub-structures · cab conditioners · docks & unloaders · dredging · fabricated piping



foundations · gantry & floating cranes · gas & oil pumping stations · locks and dams · ore & coal bridges · process equipment · pumphouses & intakes

river sand and gravel · sintering plants · slopes, shafts, tunnels · space heaters · steel grating · towboats, barges, river transportation

WHO'S WHO IN UNITARY AIR-CONDITIONING*

Manufacturers...models... certified ratings. New listing now available.

This newest edition of the ARI Directory of Certified Unitary Air-Conditioners lists all participating manufacturers, their models, and certified ratings. It also explains this ARI program, which is specifically designed to help *you*. It provides standard rating capacity and dispels confusion for prospective customers.

The manufacturers (and their models) listed here are "blue bloods" of the industry. However, nothing is accepted merely on face value. Each model of certified unitary equipment must be of proven merit. Briefly, here's how the ARI Certification program works:

ONE: A test unit is selected *at random* from a distributor's stock. Comprehensive and closely-controlled tests are run on this unit for a total actual testing time of 22 hours. These tests determine whether the unit meets its advertised capacity—and other claims.

TWO: If, at any time during the testing, a unit breaks down or does not measure up to specifications, the manufacturer is immediately notified. He then has just 30 days, after final conclusions are reached, in which to revise his production procedures, or his rating, or otherwise bring his equipment up to specifications. If this is not done, the unit must be dropped from production immediately and it is rejected for inclusion in the ARI Seal of Certification program.

This Directory, together with the tests, is the backbone of the ARI certification program. The Directory not only gives you the names of participants, but lists each model and its certified rating. For free copies of the Directory for yourself or your customers, just write to: Chief Engineer, Department **H-10**, *Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., NW, Washington 6, D. C.*

*"Unitary" air-conditioners: all packaged air-conditioners, whether single units or combined units designed to be used together (called "split" systems), up to 135,000 btuh in capacity, but not including room air-conditioners or heat pumps.

RECENT TRADE LITERATURE
Continued

Corp., 3301 *Medford St., Los Angeles* 63, *Calif.*

▶ *GATE VALVES*—in sizes from 2 to 30 in. with screwed or flanged ends; service rated at 125 psi; detailed in circular which gives service ratings, material specifications, full sizes, and dimension. *Walworth Co.*, 750 *Third Ave., New York* 17.

▶ *GEARMOTORS*—available from $\frac{1}{4}$ to 100 hp described in bulletin "51B9172" covering integral and all-motor types including right angle as well as special designs. *Allis-Chalmers Mfg. Co., Milwaukee* 1, *Wis.*

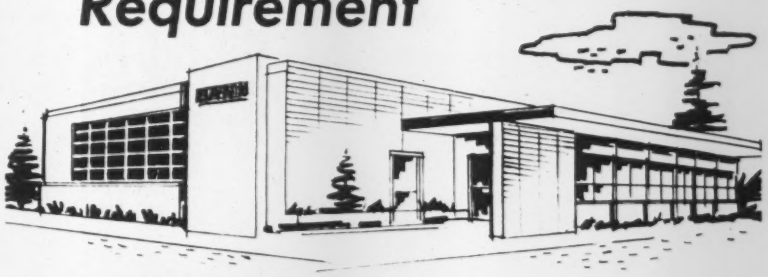
▶ *HEAT EXCHANGERS*—sized to match condensing units from $\frac{3}{4}$ to 10 ton cooling capacity, discussed in bulletin "160" containing diagrams and dimensions of exchanger which has maximum operating pressure of 300 psig. *Bohn Aluminum & Brass Corp., Betz Div., Danville, Ill.*

▶ *HEAT TRANSFER EQUIPMENT*—including heat exchangers, indirect fired heaters, tank heaters, tank suction and line heaters, process heaters and coolers, packaged boilers, as well as custom built equipment in bulletin "593." *Brown Fintube Co.*, 514 *Huron St., Elyria, O.*

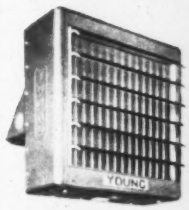
▶ *HORSEPOWER NOMOGRAM*—applicable to fractional horsepower motors and transmissions; rpm scale from 0.5 to 500; torques to 300 lb-in. on one scale and to 600 lb-ft on other; horsepower scales for corresponding values of torque and rpm. *Merkle-Korff Gear Co.*, 213 *N. Morgan, Chicago* 7.

▶ *HTHW BOILERS*—of vertical and horizontal design are described in detail along with schematic diagrams of both types of new booklet; includes construction details, design features, capacities. *Boiler Engineering & Supply Co., Phoenixville, Pa.*

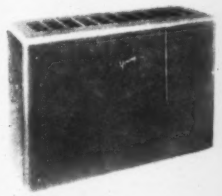
There's a Young Unit Heater for Every Requirement



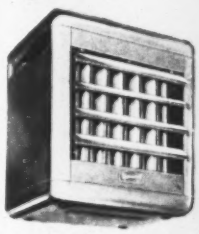
VERTIFLOW® UNIT HEATERS by Young are ideal for heating areas with high ceilings and large clear spans. Exclusive cooling stack design prolongs motor life. Wide variety of discharge outlets available. Write for Catalog No. 2659.



TYPE H (horizontal) UNIT HEATERS by Young provide quick dependable heat for factories, garages and service areas where heating requirements are subject to considerable variation. Write for Catalog No. 2557.



CABINET UNIT HEATERS by Young offer maximum heat output in a wide range of capacities and attractive models. Write for catalog No. 6556-A.



GAS-FIRED UNIT HEATERS by Young are the answer for fast spot heating in areas where steam or hot water lines are not available. Output from 24,000 Btuh to 184,000 Btuh in wide range of sizes. Write for catalog No. 2758.

Capacities and piping diagrams are complete in each catalog. Write for one or all.

Young *ideas for solving heat transfer problems are GOOD IDEAS*

YOUNG RADIATOR COMPANY DEPT. K-519 RACINE, WISCONSIN

PLANTS AT RACINE, WISCONSIN AND MATTOON, ILLINOIS

Install Insulation with

TUFF-BOND

Super-Strength Adhesives

TUFF-BOND #7
. . . fire-retardant adhesive for installing insulation

TUFF-BOND M-102-H
. . . economical duct liner adhesive

TUFF-BOND 21-C
. . . clear lap sealer and lap adhesive

TUFF-BOND 21-W
. . . white lap sealer and lap adhesive

TUFF-BOND #500
. . . exceptionally high-strength chemical-set adhesive with wide thermal range −100° F. to 350° F.

TUFF-BOND #1000
. . . high heat resistance for bedding and installing high temperature insulation

TUFF-BOND #12
. . . high pressure duct sealer

TUFF-BOND QUIK-SET
. . . neoprene-base, fast-setting adhesive. Recommended for installing metal and nylon hangers to smooth surfaces.

TUFF-BOND GENERAL PURPOSE IMPROVED
. . . all-around adhesive for installing insulation, insulation hangers, etc.

Ask for descriptive literature and prices.

GOODLOE E. MOORE
INCORPORATED
DANVILLE 26, ILLINOIS

RECENT TRADE LITERATURE

Continued

▸ *HYDROSTATIC MEASUREMENTS*—information contained in pocket-size handbook; includes description of instruments, engineering data, conversion tables, viscosity charts, tank volume formulae. *Petrometer Corp., 43-22 Teuth St., Long Island City 1, N. Y.*

▸ *INDICATING CONTROLLERS*—which indicate any measureable variable as voltage or resistance change described in new bulletin "66." Also provides information on sensitivity, accuracy, control and alarm function installation, operation, and maintenance. *Thermo Electric Co., Inc., Saddle Brook, N. J.*

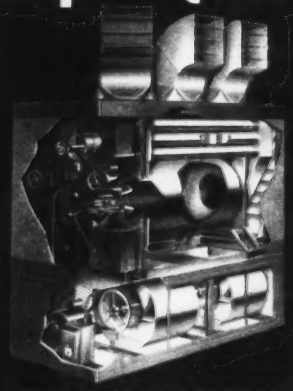
▸ *INDUSTRIAL GASES*—in new catalog "ADC 392" covering commercial applications; includes section on delivery and storage; contains conversion data table and table on physical properties of various gases. *Air Reduction Sales Co., 150 E. 42nd St., New York 17.*

▸ *MAKEUP AIR UNIT*—for commercial and industrial buildings described in bulletin "EN-5911." Outlines design of system and how to select correct equipment for such systems; includes schematic diagram and instructions for properly wiring controls. *Reznor Mfg. Co., Mercer, Pa.*

▸ *MARKING MACHINE*—new catalog gives data on metal marking machines, name plate stamping machines, hand operated pneumatic and motor driven marking and numbering machines, machines for plastics, paper, wood, fiber, and other materials. *Acromark Co., 531 Morrell St., Elizabeth, N. J.*

▸ *METAL PACKINGS*—for pump engines and compressors in bulletin "AD-11o." Gives data on correct selection, application, and installation of metal packing with explanatory illustrations. *Garlock Packing Co., 133 Main St., Palmyra, N. Y.*

Super-Quiet



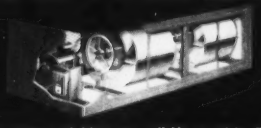
LENNOX

"OG" SERIES INDUSTRIAL HEATER

- Blower moves huge volumes of air at extremely quiet sound levels
- Rugged blower shaft design eliminates vibration problems

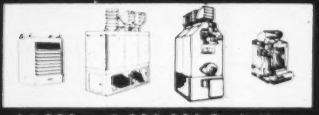
The "OG" blower incorporates self-aligning, permanently lubricated ball bearings. Blower motor is mounted on adjustable slide rails, and the entire section is easily accessible for service. This is just a sampling of why the "OG" is "stepping ahead" in industrial heating.

Wide Choice of Air Volume Capacities



Blower motors and drives are available to satisfy all air volume requirements up to 2 in. external static pressure.

LENNOX "Task Matched" Equipment to control and condition air for industry



64,000 to 2,000,000 Btuh Units

CLIP AND MAIL FOR FREE SPEC SHEETS

LENNOX Industries Inc.

INDUSTRIAL DIVISION
Box 1294, Dept. HP-10,
Des Moines 5, Ia.

Please send me—without obligation—complete specifications and engineering data on Lennox "OG" Series Industrial Heaters

Name _____

Company _____

Address _____ City _____

Title _____

Perfect air diffusion for electronic computers with ANEMOSTAT AIR DIFFUSERS

High heat return from computer equipment and from high intensity lighting is efficiently controlled by air diffused through scientifically designed Anemostat Air Diffusers.

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Representatives in Principal Cities

RECENT TRADE LITERATURE

Continued

▶ *OIL AND GAS BURNER*—folder shows burner in normal operating positions, with burner assembly swung open, and from fireside; also shown is cutaway illustration showing burner system installed on 400 hp package boiler. *Boiler Engineering and Supply Co., Phoenixville, Pa.*

▶ *PIPE COILS, FIN COILS*—for variety of applications in new edition of engineering data book; includes tabulation of all problems involving application, design, specifications, and depressant factors for pipe coils when operating at high altitudes. *Rempe Co., 342 N. Sacramento Blvd., Chicago* 12.

▶ *PIPE FITTING INSULATION*—for indoor and outdoor lines up to 400 F, presented in bulletin "TD-105-1" containing design features, specifications, dimensional data. *Fibrous Glass Products, Inc., Alpa Plaza, Hicksville, N. Y.*

▶ *PROCESS CONTROLS*—for control of materials in motion described in bulletin "5-1" including meters, feeders, instrumentation, control systems, and process equipment; lists features, accuracy, capacity, models, and sizes of each. *B-I-F Industries, Inc., 345 Harris Ave., Providence* 1, *R. I.*

▶ *RADIANT HEATING*—slab construction report gives installation procedures showing position of pipe coils in concrete slab as well as relationship of coils and slab to structural features of grade and above grade construction. *A. M. Byers Co., Pittsburgh* 30, *Pa.*

▶ *REFLECTIVE INSULATION*—new pamphlet discusses solutions to problems connected with moisture control, wall and ceiling use; includes installation diagrams, winter-summer performance comparisons; and costs of material. *Reflectal Corp., 200 S. Michigan Ave., Chicago* 4.

▶ *REFRIGERANTS*—listed in new data sheet including physical, chemical, and performance characteristics; includes table of vapor pressure for five refrigerants over temperature range from —150 to 200 F. *Fluorocarbons Div., Union Carbide Chemicals Co., 30 E. 42nd St., New York* 17.

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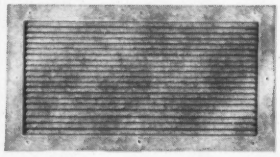
AGITAIR® REGISTERS and GRILLES

AGITAIR registers and grilles are available in a wide range of sizes and styles to meet every requirement of the architect and designer.

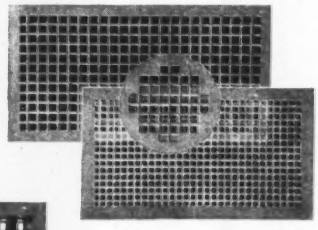
Available in all aluminum, stainless steel, bronze, brass, standard steel and plated finishes. Finish thoroughly baked on hard. Will not chip. When you specify these AGITAIR units, you are specifying quality items.

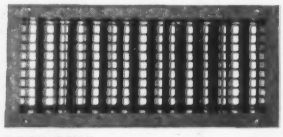
Ask your AGITAIR representative for your copy of this 32 page catalog or write to Air Devices Inc.



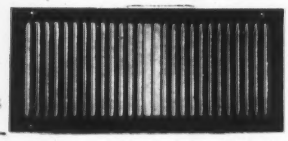
SIGHT TIGHT GRILLES

PLAIN LATTICE GRILLES





REGISTERS

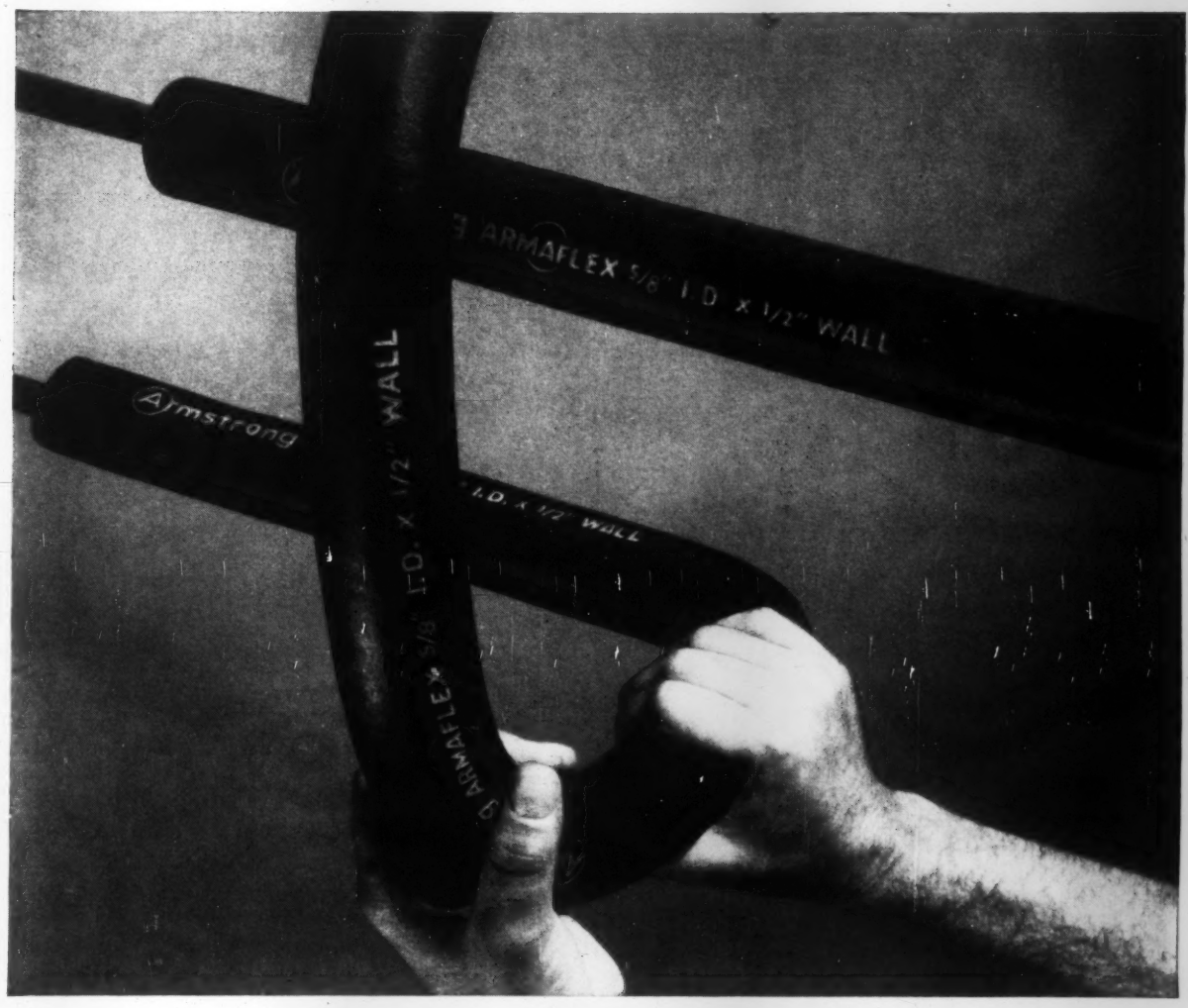


GRILLES

AIR DEVICES INC.

185 MADISON AVE. • NEW YORK 16, N. Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST



An Armstrong Armaflex specification means a low-cost, dependable pipe insulation job

A lot of pipe insulation specifications have become old-fashioned since Armstrong Armaflex was introduced less than four years ago. In that short time, this flexible foamed plastic material has moved from the specialty class to a position of major importance in the insulation field.

The reason is simple. With Armaflex you get a neater, faster, lower cost, more dependable job than with traditional pipe insulations. Armaflex is recommended for all piping operating from 0° to 200° F. It is made in three thicknesses and in sizes up to 3" IPS. Larger piping and equipment can be insulated with Armaflex sheets.

If you would like to compare your current pipe insulation specifications with the Armstrong Armaflex recommendations, send for the specification booklet today. This 12-page booklet contains complete Architects' and Engineers' Specifications and recommended Installation Instructions for the Contractor. Mail the coupon for your free copy.

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Please send me complete specifications on Armaflex without cost or obligation.

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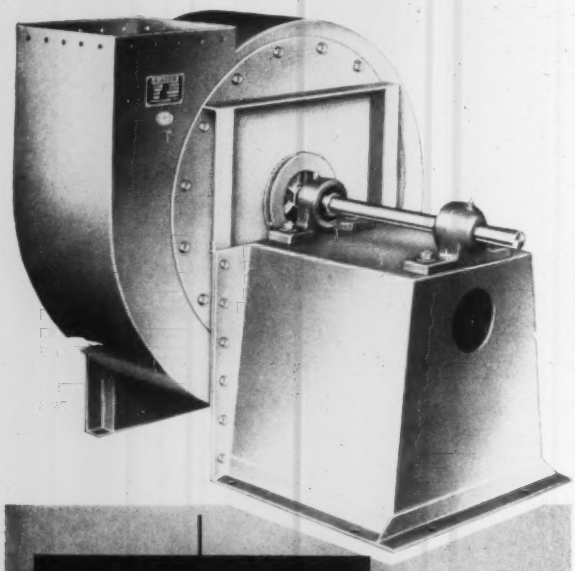
Company

Street

City Zone State

Aladdin
AIR HANDLING EQUIPMENT



TYPE
"EX"
INDUSTRIAL
EXHAUSTER

- RUGGED
- EFFICIENT
- DEPENDABLE

ALADDIN Industrial Exhaust Fans are all-welded steel plate-construction. They are ideal for material handling such as conveying grains, shavings and sawdust, or for dust removal from grinding of buffing wheels. The EX fan is also the first choice for many jobs where fumes, hot air or gasses must be handled by a rugged, efficient, dependable fan.

Write for complete data

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

RECENT TRADE LITERATURE

Continued

▸ *REMOTE ROOM CONDITIONERS*—available in 200, 300, 400, 600 cfm capacities are illustrated in catalog "381A" containing specifications, heating and cooling capacities, and dimensions. *Acme Industries, Inc., 600 N. Mechanic St., Jackson, Mich.*

▸ *SERVICE MANUAL* covers commercial and industrial air conditioners; includes oil specifications for motor-compressor assemblies, wire and fuse sizes; also has check chart of possible breakdown causes and remedies; contains wiring diagrams of all electrical components. *Embassy Steel Products, Inc., 890 Stanley Ave., Brooklyn 8, N. Y.*

▸ *SOLAR SCREENS*—and their uses indoors and out to reduce heat gain described in brochure "MFL-559-138" showing six basic patterns. *Malvern Flue Lining, Inc., Malvern, O.*

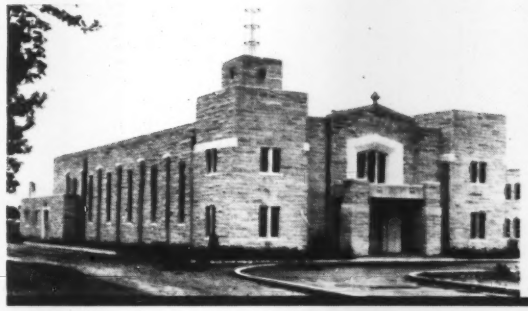
▸ *SOUND CONTROL* catalog "60" includes new line of noise reduction panels and new models of air conditioning and ventilating system silencers; provides complete dimensions for all models. *Elof Hansson, Inc., 711 Third Ave., New York 17.*

▸ *STAINLESS TUBING*—properties, sizes, and specifications described in new data card "TDC-195." *Babcock & Wilcox Co., Tubular Products Div., 712 Eleventh St., Beaver Falls, Pa.*

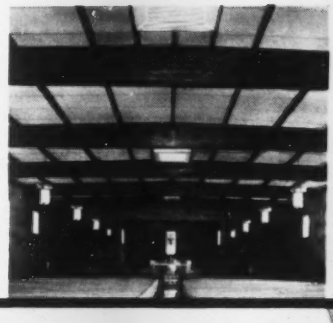
▸ *STEAM GENERATORS* features outlined in new bulletin "3000" including design and construction; bulletin "3005" gives dimensions, engineering data; "3010" has specifications; "1600" provides information on boiler accessory equipment. *Preferred Utilities Mfg. Corp., 11 E. 42nd St., New York 17.*

▸ *TUBE FITTINGS* shown in photographs and drawings in new catalog illustrating flare tube fittings, straight thread and hydraulic accessories. *Lenz Co., Dept. 63-A, 3301 Klepinger Rd., Dayton 10, O.*

▸ *VALVE MOTORS* with yoke assembly in specification "S1016-2" which includes motor data and features, force ratings. *Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.*



as **quiet** as a church



as **dependable** as the U.S. mail

THE ATMOS-PAK CONDITIONS THEM ALL

Offering a broad range of application . . . that's how we describe this original, roof-mounted, year-round, pre-fabricated air conditioning system. Primarily designed for the flat-roofed structure, the Atmos-Pak has proven especially versatile with almost any application being made possible by our 10 models of 5 through 35 tons.

This air-cooled conditioning system eliminates duct work as the supply and return air ceiling diffuser is directly connected to the unit. To suit a particular specification, however, duct work can be incorporated.

Whether a large or small installation . . . whether a factory, store, office or church . . . the Atmos-Pak conditions them all. Why not write for our new bulletin today?

the atmos-pak ®

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AIR CONDITIONING, INC.

88 North Highland Avenue
Ossining, New York

as **economical** as a supermarket

as **efficient** as a modern plant

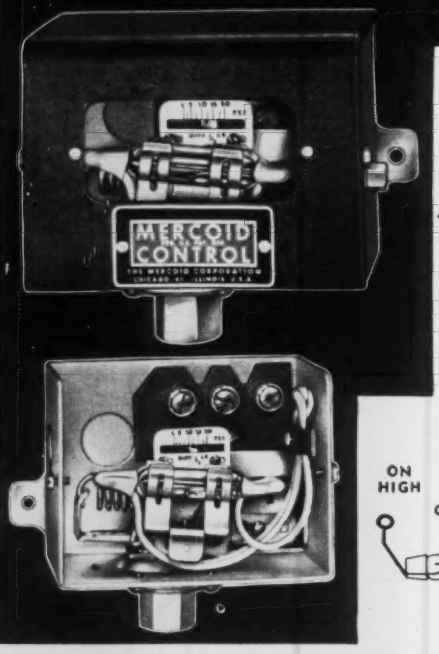
THERE'S ALWAYS ROOM ON TOP FOR THE ORIGINAL LOW SILHOUETTE.

NEW

Small, Lightweight

MERCOID®

PRESSURE CONTROL



For Mediums Not Injurious To Steel Or Silver Solder

Type AP-153 control incorporates a single pole, double throw Mercoid hermetically sealed mercury switch (4A. 115V., 2A. 230V.). The control will provide single pole cut-in high; single pole cut-in low, or single pole double throw operation.

OPERATING RANGES

ADJUSTABLE OPERATING RANGE	SWITCH DIFFERENTIAL PSIG. With Pointer Set At		MAXIMUM LIMITS SURGE
	LOW	HIGH	
1 to 20 psig.	0.3	0.5	30 psig.
1 to 30 psig.	0.4	0.75	40 "

ADJUSTMENT: External.
PRESSURE ELEMENT: Fairprene diaphragm.
PRESSURE CONNECTION: ¼" I.P.S.
MOUNTING: Has two mounting ears (one on each side of control) or control may be pipe mounted by means of the ¼" I.P.S. bottom connection.
WIRING ENTRANCE: Two ½" openings
INTERNAL WIRING CONNECTIONS: 3 post terminal block.
SWITCH LEADS: Silicone rubber covered.
CASE: NEMA 1—Heavy gauge steel, cadmium plated. Steel cover (with glass front) finished in charcoal-gray.

WRITE FOR BULLETIN 02

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.
New York: 205 E. 42nd St. - Philadelphia: 3137 N. Broad St.

RECENT TRADE LITERATURE

Continued

▶ *VERTICAL WATER HEATERS*—in five sizes from 220 to 565 gal storage capacity and with inputs from 250,000 to 500,000 Btu per hr are listed and described in bulletin "5214" which includes dimensions and other installation data. *Sellers Engineering Co., 1776 N. Clark St., Chicago 10.*

▶ *VIBRATION CONTROL*—data sheet "59-05" presents new system application and equipment. *Barry Controls, Inc., 700 Pleasant St., Watertown 72, Mass.*

▶ *VIBRATION ISOLATORS*—for protection of delicate instruments, engines, compressors, and motor-generators; illustrated in bulletin "59-04" containing selection of graphs. *Barry Controls, Inc., 700 Pleasant St., Watertown 72, Mass.*

▶ *WELDING FITTINGS*—are cataloged by size, dimensional, and physical data in bulletin "FDC-253" one of a series of 24 such data folders. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee 46.*

▶ *WELDING FITTINGS AND FLANGES*—in 20 in. nominal pipe sizes in new bulletin "FDC-270" containing full data on dimensions, weight, types of fittings available. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee 46, Wis.*

▶ *WELDING FITTINGS AND FLANGES*—in 14 in. nominal pipe sizes in new bulletin "FDC-267" containing full data on dimensions, weight, types of fittings available. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee 46, Wis.*

▶ *WELDING MACHINES*—illustrated in catalog "EW-209" including specifications on gasoline and diesel engine driven welders, electric motor driven arc welders, rectifier type welders, transformer type welders, a-c d-c inert gas shielded arc welders, and other welding equipment. *Hobart Brothers Co., Troy, O.*

▶ *WELDING POWER SOURCES*—in bulletin "ADR 121" offers comprehensive guide to proper selection of a-c welders for gas shielded tungsten-arc, or gas shielded metal arc welding processes. *Air Reduction Sales Co., 150 E. 42nd St., New York 17.* ≠

WHO'S WHAT...

(New personnel, promotions)

▶ *EUTECTIC WELDING ALLOYS CORP.*—Robert F. Fox, national sales manager.

▶ *STANDARD TUBE CO.*—Paul J. Selinger, manager of product development.

▶ *TACO HEATERS, INC.*—Peter Quattrochi, sales manager.

▶ *BAILEY METER CO.*—K. R. Dodson, resident engineer in Corpus Christi, Tex.

▶ *BLACK & DECKER MFG. CO.*—G. Harvey Porter, advertising manager; John F. Apsey, Jr., director of public relations.

▶ *YOUNGSTOWN SHEET AND TUBE CO.*—Thomas G. Sanders, market analyst in commercial research; Robert G. Griffith, superintendent of seamless tube mills, Campbell works; Marcus V. Appleman, assistant superintendent of couplings dept., Campbell works.

▶ *BRUCH, MORROW AND KNAFLA, INC.*—Raymond A. Dickman, associate member of consulting engineering firm.

▶ *WESTERN SOCIETY OF ENGINEERS*—Fred R. Bruce, secretary.

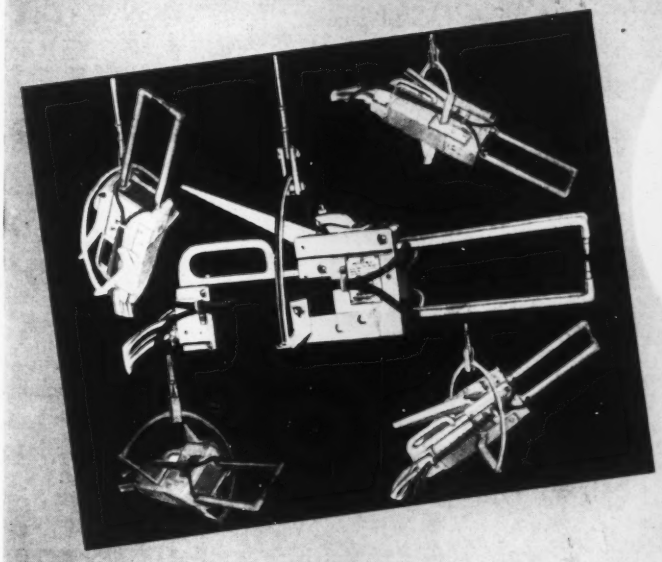
▶ *CARRIER CORP.*—John F. Kooistra, director of marketing services, machinery and systems div.; Jordan E. Pengel, marine coordinator.

▶ *CONTROLS CO. OF AMERICA*—H. B. Wilgus, general sales manager.

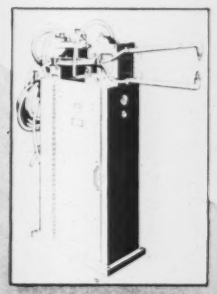
▶ *ALLIS-CHALMERS MFG. CO.*—Robert R. Walker, sales manager; Hugh H. McDaniel, assistant sales manager; Marvin Buege, chief of contract administration; Hugh B. McGreal, project co-ordinator; A. J. Bennett, administrative assistant to the sales manager; Leonard H. Sence, assistant to manager of centrifugal pump dept.

▶ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—Dr. Finn J. Larsen, vice president in charge of research; James H. Binger, elected to board of directors; William F. Newbold, director of research for Brown Instruments Div.

HANDY... any way you look at it



Ball bearing suspension ring takes all the weight and much of the work out of welding with a Miller MPS water-cooled portable spot welder. Choice of manual or air operated models, all with timers. 6" tongs secure work with pressure to 600 pounds. Model MPS-10-KVA weighs 79 lbs., welds up to 3 16" thickness; model MPS-20-KVA, 91 lbs., handles material to 1/4"; air operated models average 53 lbs. more. Wide choice of tongs.



Steel pedestals are available for both models

miller ELECTRIC MANUFACTURING COMPANY, INC.

APPLETON, WISCONSIN

distributed in Canada by CANADIAN LIQUID AIR CO., LTD., Montreal

PROBLEM:

Cooling towers—find a nozzle that delivers large droplets at low pressure

SOLUTION:

Delavan Types WR or WC nozzles

Both these Delavan nozzles operate effectively at pressures as low as 2 psi. Produce large droplets with minimum drift-age. Clogging is held to a minimum. There are no vanes, cores or other obstruction to promote corrosion build-up. WR and WC deliver uniformly distributed, hollow cone patterns for maximum heat transfer. They're accurately calibrated to the capacity and spray angle you request. A wide range of capacities, pipe sizes and materials is available.

If the right nozzle will improve your air conditioning equipment, there's a Delavan nozzle that will do it better. Write for Catalog 33A today.

DELAVAN
Manufacturing Company
WORLD'S LARGEST MANUFACTURER OF NOZZLES • WEST DES MOINES • IOWA

WHO'S WHAT

Continued

▶ *A. M. BYERS CO.*—William V. Wilkinson, field service engineer for State of Virginia.

▶ *COMBUSTION ENGINEERING, INC.*—Vincent P. Owens, assistant general sales manager in charge of industrial products.

▶ *AURORA PUMP DIV. OF NEW YORK AIR BRAKE CO.*—John M. Bals, general manager.

▶ *OHIO BRASS CO.*—Hugh J. Clark, manager of valve dept.

▶ *CONTINENTAL BOILER DIV. OF BOILER ENGINEERING AND SUPPLY CO., INC.*—Joseph A. Hohenleitner, sales manager.

▶ *DRESSER MFG. DIV. OF DRESSER INDUSTRIES INC.*—Charles Kuhn, vice president-sales manager.

▶ *WESTINGHOUSE ELECTRIC CORP.*—T. J. D. Dunphy, manager of marketing services; C. E. Cannon, manager of sales promotion and training; both with air conditioning division.

▶ *PHOTOMATION, INC.*—Howard G. Hellen, sales and marketing engineer.

▶ *BOHN ALUMINUM & BRASS CORP.*—Charles M. Hull, manager of the industrial coil department.

▶ *ORR & SEMBOWER, INC.*—Ronald C. Currie, vice president and marketing manager.

▶ *UNITED STATES GYPSUM CO.*—George D. Sudlow, merchandise manager, mineral wool products.

▶ *CLAYTON MARK & CO.*—G. E. Rogers, national accounts sales manager; Lee S. Tillery, product sales manager Pump Div.; Gerald J. Hensler, field manager; Herbert Agase, product sales manager.

▶ *LUNKENHEIMER CO.*—Louis T. Huser, controller-assistant treasurer elected president of Cincinnati Control-of Controllers Institute of America.

▶ *AIR FILTER CORP.*—William Welty, vice president in charge of sales.

WHO'S WHAT

Continued

▶ *DRAVO CORP.*—Donald A. Booth, engineering manager, engineering works div.

▶ *RAYTHEON CO.*—Stuart D. Cowan, director of commercial marketing services.

▶ *AMERICAN-STANDARD INDUSTRIAL DIV.*—William J. Fitzgerald, manager of market research operation; Robert G. Schreiner, marketing manager—heat exchanger products.

▶ *REYNOLDS GAS REGULATOR CO., INC.*—Clarence E. Baker, coordinator of sales.

▶ *JOHN WOOD CO.*—C. E. Woollen Jr., manager of product engineering and development.

▶ *ARKLA AIR CONDITIONING CORP.*—Donald Kuhlenschmidt, development engineer.

▶ *FILTER MFG. CO.*—Charles R. Muth, advertising manager.

▶ *WHEEL TRUEING TOOL CO.*—Leo Catallo, Detroit factory manager; Tad Bemben, Detroit factory superintendent.

▶ *DRAYER-HANSON DIV. NATIONAL-U.S. RADIATOR CORP.*—Thomas E. Mathison, supervising catalog publications section.

▶ *WALWORTH CO.*—Warren G. Parmenter, manager of plastics section.

▶ *UNITED WIRE & SUPPLY CORP.*—Edward J. D'Amore, service sales manager for brazing and wire divisions.

▶ *KEASBEY & MATTISON CO.*—Hodges B. Childs, secretary.

▶ *RECOLD CORP.*—Carl Baumhofer, works manager.

▶ *NATIONAL-U.S. RADIATOR CORP.*—Zygmund A. Gonglewski, personnel and industrial relations assistant.

▶ *DUNHAM-BUSH, INC.*—William G. Smith, sales engineer in St. Louis; Wallace G. Hamilton, application engineer in Minneapolis.

DO YOU FIND YOUR PUMP PROBLEM HERE?

A Water Supply, Air Conditioning, Refrigeration, Cooling Towers, Sump Pumping, Etc.

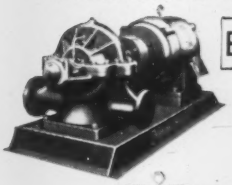
B Booster Service, Cooling Towers, Water Treatment, Water Circulation, Brine Service, Etc.

C Hot Water Circulation, Ice Water or Brine, Clear Water, Boilers, Booster Service, Etc.

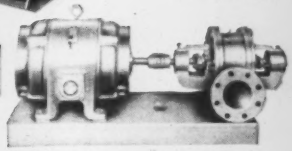
D Hot and Cold Liquids, Refrigerants, Boiler Feed, Cooling Towers

Then You'll Find Your Best Answer Here—

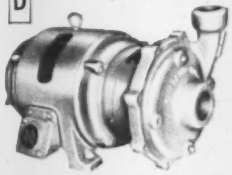
A **F-M Pomona Water-Lubricated Turbine Pumps** Easily installed, easy to adjust for varying field conditions. Available with wide choice of drivers.



B **F-M Split-Case Centrifugal Pumps** Capacities, pressures and sizes for any requirements. Single-stage or multistage.



C **F-M Westco Peripheral Pumps** Capacities to 200 gpm. Pressures to 900 ft. Sizes 1¼" through 2½". Horizontal single-stage or multistage. Develops high pressure at normal operating speeds.



D **F-M Builtogether Centrifugal Pumps** Capacities to 900 gpm. Pressures to 525 ft. Sizes ¾" through 5". Single-stage or multistage.

***FREE!* Expert Engineering Help at Your Service**

Be *sure* of low-cost, foolproof pumping installations that match your exact requirements... call in your Fairbanks-Morse Sales Engineer. Take advantage of his broad technical background and expert knowledge of pumps for air conditioning, plumbing and heating. Call him today, or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Illinois.

See Sweet's Product Design Catalog File for complete F-M Pump Line.

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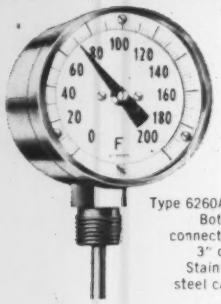
a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY
RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

TEMPERATURE MEASUREMENT

AMERICAN THERMOMETERS DO THE JOB ACCURATELY



Type 6260AH – Bottom connection. 3" dial. Stainless steel case.

They respond quickly and accurately to all temperature changes, whether mounted on a blower in a basement or on air conditioning equipment on a roof. American Bi-Metal Dial Thermometers combine superior resistance to vibration with the greatest sensitivity in bi-metal actuation. Two other advantages provide extra value:

ANTI-PARALLAX MAXIVISION® DIAL guarantees surest, sharpest, easiest readings. It is a split-level dial constructed with graduations and pointer on the same plane. No perspective effect. No parallax error in reading. Only American Thermometers have this feature.

WEATHERPROOF CONSTRUCTION seals out all atmospheric and application conditions that might cause erosion, corrosion, inaccuracy and shorten service life.

Wherever accurate temperature measurements are essential—whatever the operational temperatures of the heating or air conditioning system – choose American Thermometers. Mounting styles include the "Every Angle" thermometer you can set for face-to-face readings wherever installed. Dial sizes, temperature ranges and stem lengths to meet your needs exactly. *Write for Catalog 100.*

Type 6360AH – Back connection. 3" and 5" dials. Stainless steel case.

Type 6060AH – "Every Angle" connection permits setting at any point within 180° on two axes. 5" dial. Stainless steel case.

Type 6360AH – Back connection. 2" dial permits installation in close quarters without sacrificing readability. Stainless steel case.

MAXWELL MANNING MM&M TRADE MARK

AMERICAN THERMOMETERS

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

WHO'S WHAT

Continued

▸ *DURO-DYNE CORP.*—R. A. Johnson, Jr., assistant to president.

▸ *WESTINGHOUSE ELECTRIC CORP.*—James W. Wilcock, manager of Sturtevant Div.

▸ *YORK DIV., BORG-WARNER CORP.*— A. E. Diehl, assistant manager, Hartley plant.

▸ *UNIVERSAL INSULATING MACHINE CO.*—Earl F. Sommers, chief engineer and plant manager, of new Winter Haven, Fla. facilities.

▸ *McGRAW-EDISON CO.*—E. W. Hendrickson, general manager, HeaTube dept., Coolerator Div.

IN THE TERRITORIES . . .

(Recent sales appointments)

▸ *INLAND STEEL PRODUCTS CO.*—Harold E. Rossiter, Cleveland branch manager, Commodity Products Div., M. R. Greene, regional supervision.

▸ *J. E. LONERGAN CO.*—Mooney Engineering Co., Inc., representative in Kansas City, Mo. area.

▸ *FLEXIBLE TUBING CORP.*—Stephen K. Hawkins, national sales manager - general products, Hillside, Ill.; G. William Loveday, assistant to the president, Guilford office; A. H. Loux, regional manager - general products, Guilford office; Wesley L. Guiles, regional manager - technical sales, Guilford office; Lew W. Crockett, Jr., regional manager - general products, Atlanta, Ga. office; Joseph H. Dendy, regional manager - general products, Cleveland office; Marvin K. Gardner, regional manager - general products, Dallas office; John D. Kohler, regional manager - technical products, San Francisco office; George A. Booth, regional manager - general manager, Hillside, Ill. office; James T. McFarland, regional manager - general products, Anaheim, Calif. office; Robert H. Stevenson, Jr., regional manager technical products, Dayton, Ohio office.

▸ *SUNDSTRAND HYDRAULICS, DIV. OF SUNDSTRAND CORP.*—John F. Griffey, sales engineer in midwest; James R. Holmin, sales engineer in east; Ray W. Kiefer, office service manager.

WHO'S WHAT

Continued

▸ *OLIN MATHIESON CHEMICAL CORP.*—McCormick Steel Co., distributor for Olin Aluminum in Texas, Louisiana, New Mexico, Oklahoma, Kansas and parts of Arkansas; Steel Distributors, Inc., Philadelphia distributor.

▸ *WEBSTER ELECTRIC CO.*—L. E. Woolf, sales representative for Alabama, Delaware, Florida, Georgia, Maryland, Mississippi, New Jersey, North and South Carolina, Virginia, most of Pennsylvania, some areas of New York City, Washington, D. C.

▸ *NATIONAL SUPPLY CO. TUBULAR DIV.*—William J. Wardle, sales representative, Philadelphia office.

▸ *SOLAR AIRCRAFT CO.*—Ladt Engineering Co., representative in southwestern Indiana, southern Illinois, southeastern Missouri, and northern Mississippi, western parts of Tennessee and Kentucky.

▸ *RITTLING CORP.*—Consolidated Supply Co., sales representative for Maryland, west to and including Frederick County, exclusive of Cecil County and Washington, D. C., Sussex and Kent Counties in Delaware.

▸ *BABCOCK & WILCOX CO., TUBULAR PRODUCTS DIV.*—Robert E. Halloran, Pacific coast sales manager; Thomas W. Wright, assistant manager, New York district sales office.

▸ *VIBRATION MOUNTINGS, INC.*—Melvin B. Chalfen, manufacturers representative.

▸ *OPW-JORDAN*—Robert J. Peters, regional sales manager of southeast and mid continent area.

▸ *FLEXONICS CORP.*—Robert F. Ford, district sales manager, Boston district.

▸ *TRANE CO.*—William L. Baker, Chicago sales office; J. R. Patterson, manager, Dayton sales office.

▸ *DAVIS ENGINEERING*—R. O. Barry, manager of new district factory branch office, 7256 W. Touhy Ave., Chicago.

▸ *CARRIER CORP.*—Robert C. White, western regional sales manager.

Heating and Air Conditioning

PRESSURE MEASUREMENT

ASHCROFT GAUGES DO THE JOB ACCURATELY

Ashcroft Duragauge in Phenol Case

Name the operational pressures of any heating, piping or air conditioning equipment you specify, install or service: There's an Ashcroft Gauge to measure the pressures precisely—from 30" vacuum or a few ounces to the highest psi used on any system. That is why Ashcroft Gauges are used on everything from giant boilers to small compressors.

You have a choice of three classes of Ashcroft Gauges. Each class has functional characteristics compatible with its recommended applications.

DURAGAUGES: The finest pressure gauges you can specify and install on any heating, piping or air conditioning system. Highest sustained accuracy and durability assure savings in replacements and repairs far exceeding the initial investment.

QUALITY GAUGES: Second only to the Duragauge in ruggedness and sustained accuracy. Ideal for the normal industrial, commercial and institutional equipment.

STAINLESS STEEL CASE GAUGES: The best gauges for small compressors, pumps, boilers and the less important pressure lines. Inexpensive but accurate and durable.

Whatever the medium under pressure—air, oil, water, steam, or refrigerant—select Ashcroft Gauges. Pressure, vacuum and compound ranges available. Several dial sizes. *Write for Catalog 300B.*

Ashcroft Quality Gauge in Alumalife® Case. Catalog No. 1010.

Ashcroft Gauge in Stainless Steel Case. Catalog No. 1000.

ASHCROFT PRESSURE GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

OVER 400 BURNERS REPLACED WITH THIS FUEL SAVER

LO-BLAST ECONOMITE

POWER GAS CONVERSION BURNER

In the small home development of 472 homes in Marquette Heights, near Peoria, Illinois, illustrated above, Lo-BLAST Economite Power Gas Burners replaced oil burners originally installed. The reasons are evident when the trouble-free performance and economy of the Economite are considered.

Power burner design assures perfect combustion, regardless of natural draft conditions—*saves an average of 10% in fuel*—ideal for down-draft heating plants. The Economite burns so smoothly you can't tell when it's running.

Every Economite is factory-tested on gas and shipped assembled, fully equipped with fool-proof safetys.

Lo-BLAST Power Gas Burners are available in capacities from 70,000 to 20,000,000 BTU input. Write for literature.

MID-CONTINENT
METAL PRODUCTS CO.
1960 N. Clybourn Ave., Chicago 14, Ill.

WHO'S WHAT

Continued

▶ *DUNHAM-BUSH, INC.*—Robert McCulloch, sales engineer, New York City office.

▶ *READING TUBE CORP.*—Bob Shurilla, regional manager, midwest area; Bernard Roche, Chicago district sales manager.

▶ *CRANE CO.*—Thomas R. Watson, manager, Washington, D. C. branch; Robert E. Settle, Jr., wholesaler zone manager for eight southeastern states; new independent wholesalers: V.M.W. Supply Co., Falls Church, Va.; N.C. Supply Co., Rocky Mount, N.C.; Southwestern Supply Co. in Pueblo and Grand Junction, Colorado.

▶ *MODINE MFG. CO.*—Paul Minster, partner with Staup & Harris Assoc., representatives; Edward Mills, sales engineer; David W. Lemke, sales engineer.

▶ *MASON-NEILAN DIV. OF WORTHINGTON CORP.*—Fryer & Co., distributors in Washington and Oregon.

▶ *POWERS REGULATOR CO.*—E. J. O'Donnell, district manager for Minneapolis, Omaha, Des Moines, Fargo and Sioux Falls offices; Richard L. Bumgardner, Minneapolis branch manager; Donald Nelson, Peoria branch manager; Ben F. Jones, in charge of new Tampa office.

▶ *DRAVO CORP.*—George R. Biedler, manager of Atlanta, Ga. sales office.

▶ *WHITE-RODGERS CO.*—James R. Hillin, sales engineer for Georgia, Florida, North and South Carolina.

▶ *RECOLD CORP.*—Archer-Hinman Supply Co., wholesaler for Tulsa, Okla. area.

▶ *JOSEPH T. RYERSON & SON, INC.*—Charles C. Lund, sales manager, Chicago metropolitan sales district; Robert H. Walker, sales manager, Minneapolis district; Frank T. Elmgren and James L. Robb, field representatives for Houston; Russell D. Evans, sales for east Texas and Louisiana.

▶ *SPORLAN VALVE CO.*—John Adams, sales engineer, Atlanta office, David Sahler, sales engineer, Dallas office.

▶ *YOUNG RADIATOR CO.*—Russell G. Beck, Jr., southern district sales supervisor.

WHO'S WHAT

Continued

▶ *PETROMETER CORP.*—Stolley and Orlebeke, representative in metropolitan Chicago, Rockford, Peoria, Decatur, and northern Illinois and Hammond, Gary and South Bend area in Indiana.

▶ *FURNAS ELECTRIC CO.*—Joseph H. Fallon, southern Ohio and northern Kentucky sales representative; Robert W. Chapman, sales representative for North and South Carolina.

▶ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—Robert A. Wolfe, manager at Pittsburgh; Edward J. Reulbach, Jr., heading operations in Albany; Joseph H. Toifel, to Columbus, O.

▶ *JAMESBURY CORP.*—W. G. Hurd, district manager for southeastern states.

▶ *DRAYER-HANSON DIV., NATIONAL-U.S. RADIATOR CORP.*—R. S. Ryden & Co., sales agents out of San Antonio, Tex.; A. G. Kirkwood Co., sales representative, Louisiana sector.

▶ *ATLAS VALVE CO.*—Martin J. Noon, sales representative in Newark, N. J. area.

▶ *NATIONAL-U.S. RADIATOR CORP.*—Clark R. Sterling, salesman in Pacific Steel Boiler Div., Chicago office; Robert E. Walker, assistant Chicago branch manager.

▶ *ALLIS-CHALMERS MFG. CO.*—Roy E. Goodwill, Jr., manager, general products div., central region; William R. Carlyon, manager, general industrial sales, Detroit district.

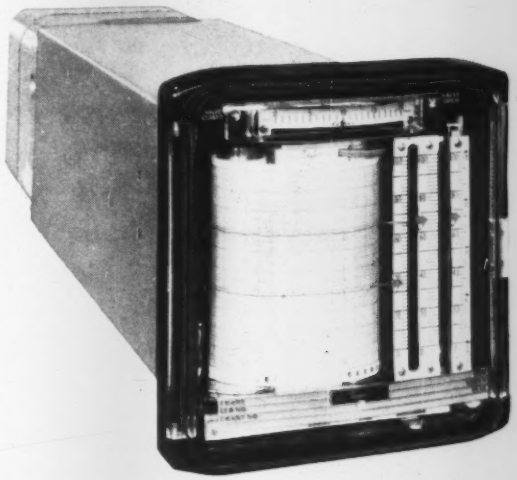
▶ *TRION, INC.*—William P. Uhler, regional sales manager of northeast central region.

▶ *COMMERCIAL IRON WORKS*—Malcolm W. Black & Co., Inc., sales representative for metropolitan New York, northern half of New Jersey, Fairfield County, Conn.

▶ *L. J. WING CO.*—John J. Hayes, New York sales manager; Bogart-Bullock Corp., southern California representative.

▶ *FIELD CONTROL DIV., H. D. CONKEY & CO.*—William J. Debler Sr. and Jr., manufacturers representatives for New England states.

EXCEPTIONAL CONVENIENCE



No other recorder, regardless of size, puts so many features in so little panel space

The Taylor TRANSCOPE® Recorder (90J) is now generally recognized as the most modern, most convenient and most accurate instrument for recording process variables at a central point.

Servo-Operated Pens assure unprecedented accuracy of records.

Front of Panel Control Settings let you make adjustments easier, quicker and better . . . *from the front of panel* . . . while recording!

Stays on Automatic Control while the plug-in recorder slide is removed for inspection, yet providing continuous fully automatic control.

Complete Indicating Control Station while recorder is removed. Horizontal gage at top of recorder will show either process variable or air output to valve, as desired.

Receives Three Variables to be recorded or indicated; has a Set Point Transmitter; Process Alarms with Memory Pointers; an Automatic-to-Manual switching lever; a cascade or Process-output Indicator, and many other features . . . all in a compact case.

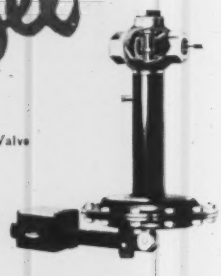
See your Taylor Field Engineer, or write for **Catalog 98286.** Taylor Instrument Companies, Rochester 1, N. Y., or Toronto, Ontario.

Taylor Instruments

MEAN ACCURACY FIRST

If you need to reduce
fluid pressure safely, economically...
call for a valve from

Klipfel

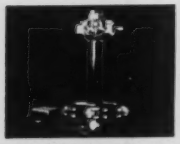


No. 310 Reducing Valve

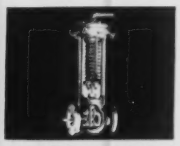
Klipfel makes Reducing Valves for every purpose — 60 different types of them, in fact. They operate on air, gas, steam, water or other liquid, with initial pressures up to 300 psi and reduced pressures as low as vacuum. You can choose from five different inner valves, three different actuating means and four loading means.

Also available from Klipfel are Float Valves, Relief Valves and Temperature Regulator Valves and special valves made of corrosion-resistant materials. For information on any valve, call your supply house or write for Catalog 54.

Call your supply house, or write for Catalog 54.



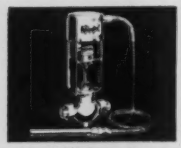
No. 410 Reducing Valve



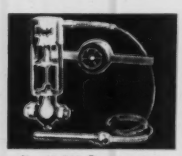
No. 300 Reducing Valve

AIR MAIL

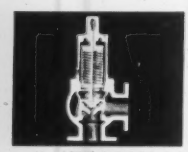
Most items shipped within 24 hours after order is received



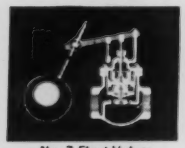
No. K-449 Temperature Regulator Valve



No. K-348 Temperature Regulator Valve

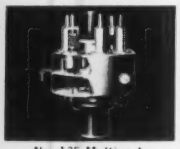


No. 135 Relief Valve



No. 7 Float Valve

No. 27 Float Valve



No. 135 Multiport Relief Valve

HAMILTON • OHIO Klipfel VALVES, INC.

Automatic Temperature and Pressure Regulating Valves Since 1902

Float Valves • Temperature Regulators • Back Pressure Valves • Reducing Valves

A DIVISION OF THE HAMILTON-THOMAS CORPORATION

WHO'S WHAT

Continued

▶ *DEMING CO.*—Charles J. Wiss, representative for California, Arizona, Utah, Nevada, and New Mexico.

▶ *DAVIS ENGINEERING*—R. O. Barry, manager of new sales office at 7256 Touhy Ave., Chicago.

▶ *TRANE CO.*—Charles E. Warren, manager of Salt Lake City office.

▶ *MID-CONTINENT METAL PRODUCTS CO.*—W. H. Lambert Co., exclusive distributors in State of Florida.

▶ *POWERS REGULATOR CO.*—Bernard G. Gardner, manager of new office at 227 W. Exchange St., Akron, O.; Vaughn C. Dee, manager of new office at 138 W. Rayen St., Youngstown, O.

▶ *ALLIS-CHALMERS MFG. CO.*—A. E. Decker, manager, eastern area of defense product div.; George O. Pierce, manager western area; Dale R. Shearburn, sales supervisor, central area.

▶ *COPPER & BRASS RESEARCH ASSN.*—Thomas F. McCarthy, field representative for eastern and New England states.

▶ *BLACK, SIVALLS & BRYSON, INC.*—Hawkins Co., manufacturer's representative in North and South Carolina.

▶ *PECK, STOW & WILCOX CO.*—Vernon Haug, salesman in midwest territory.

▶ *CORR-PREV DIV. OF CHASE & SONS, INC.*—Earl L. Jolly, Pacific-western area manager.

▶ *C. G. HUSSEY & CO.*—Gene J. Niccoli, district manager for western Pennsylvania and West Virginia.

▶ *CONTROLS DIV., BLACK, SIVALLS & BRYSON, INC.*—Jack Kohl, manager of western sales territory.

▶ *GOVERNAIR CORP.*—C. A. Dyson, representative in north area of New Jersey.

▶ *DRAVO CORP.*—Charles F. Wheelock & Assoc., distributors for territory covering most of Alabama and Mississippi and 10 counties in northwestern Florida. ±

WE HEAR THAT . . .

▶ A new firm, *STRUCTA-LUNG CO.*, has been formed to manufacture industrial power roof ventilators, fans, and industrial ventilating systems. The firm's headquarters are at 36407 Euclid Ave., Willoughby, O.

▶ *WARREN WEBSTER & CO., INC.* has acquired a twin-engined plane for executive and engineering use.

▶ *TEXAS INSTRUMENTS, INC.* will begin a 9600 sq ft expansion of its Versailles, Ky. plant. Occupancy of the addition is expected in November.

▶ In conjunction with its 50th year in business, *BLACK & DECKER MFG. CO.* recently held a general convention of its sales organization. The meeting was held from Sept. 20-23 at the French Lick-Sheraton, French Lick, Ind.

▶ *WARREN WEBSTER & CO., INC.* has initiated a mobile exhibit of heating and cooling equipment.

▶ *WANSON CORP.* has been incorporated to sell industrial and commercial warm-air heaters under license from *ETABLISHMENTS WANSON*, of Brussels, Belgium.

▶ *TENNEY ENGINEERING, INC.* has purchased *COPPER & ALUMINUM DIV. OF KIRSCH CO.*

▶ As a part of its sales promotion campaign, *YORK CORP.* has a miniature desk-top theater to promote purchase of air conditioning.

▶ *GWILYM A. PRICE* has been awarded the *JOHN FRITZ MEDAL*. Presentation will be made at the A.S.M.E. annual meeting in Atlantic City in early December.

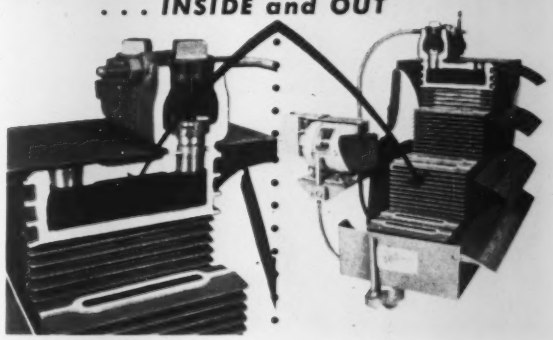
▶ *BROWN FINTUBE CO.* has now established affiliated plants in the United States, Canada, England, France and Germany.

▶ *PRESSTITE-KEYSTONE ENGINEERING PRODUCTS CO., DIV. OF AMERICAN-MARIETTA CO.* has officially change its name to *PRESSTITE DIVISION, AMERICAN-MARIETTA CO.*

▶ *FULTON SYLPHON DIV., ROBERTSHAW-FULTON CO.* recently began a traveling display of industrial control devices. The mobile display unit will tour Oak Ridge, Tenn., and Redstone Arsenal, Ala. and then continue through other areas of the U.S.

it's the material that makes the difference . . .

. . . INSIDE and OUT



CORROSION causes heating equipment failures!

BUT NOT WHEN YOU USE

GRID

cast iron construction

▶ UNIT HEATERS
▶ BLAST HEATERS
▶ RADIATORS

Designed for operation on steam pressure up to 250 PSI 450° temperature

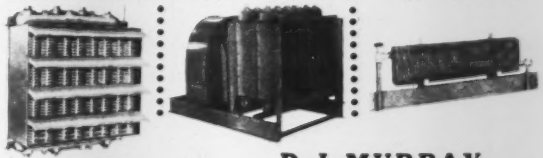
CORROSION internally, caused by electrolytic action as in copper tubes, can't happen in GRID's cast iron steam chambers and headers. Nor can acid condensate corrode the bottom connections. Cast Iron, internally, resists corrosion.

CORROSION externally, caused by acid fumes cannot destroy GRID's cast iron finned heating surface. Widely spaced fins cast integral with the steam chamber will not corrode externally.

ORDINARY HEATING SURFACES FAIL BECAUSE OF CORROSION INSIDE AND OUT! AVOID THESE COSTLY HEATING FAILURES!

Send for Catalog 956 . . . The complete story on Grid Unit Heaters, Blast Heaters and Radiators.

UNIT HEATERS BLAST HEATERS RADIATORS



INSTALL GRID CAST IRON

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883
WAUSAU, WISCONSIN
OFFICES IN PRINCIPAL CITIES

It's the . . . Sterlco®

THERMOTROL

for ACCURATE, INDEPENDENT ROOM TEMPERATURE CONTROL

STEAM or HOT WATER SYSTEMS

. . . for modernization or new construction

CAN BE KEY LOCKED

for ...

HOSPITALS, APARTMENTS, OFFICES, HOTELS, SCHOOLS, MOTELS, INSTITUTIONS and PUBLIC BUILDINGS

- **COMPLETELY SELF-CONTAINED**
  Each Sterlco Thermotrol is a complete temperature control unit, easily installed in any two-pipe system in place of the manual valve. NO wiring or other external connections needed.
- **MODULATING CONTROL—NOT on AND off**
  Each Sterlco Thermotrol provides steady, even control to each radiator the way YOU want it. Radiators in cold spots give off heat while those in warmer parts of the same room are automatically throttled down.
- **NO ELECTRICAL CONNECTIONS**
  No electric wiring, additional piping, or other connections are required with the Sterlco Thermotrol. Just as easily installed for modernization as for new construction.

FOR BUILDING MODERNIZATION

With a Sterlco Thermotrol on each radiator, stuffy overheated rooms, open windows, and excessive fuel bills are eliminated. You pay for only the heat you need . . . rooms are comfortably, evenly warm . . . occupants comfortable.

FOR NEW CONSTRUCTION

Here's modern ZONE CONTROL for radiant systems. The only modern solution to inefficient "on-off" valves and expensive, motorized valves.

STEAM HEATING IS MODERN, EFFICIENT and DEPENDABLE

Sterlco Products Distributed through

LEADING HEATING and PLUMBING WHOLESALERS

STERLING, INC.

5202 W. Clinton Ave., Milwaukee 18, Wis.

CONDENSATION AND VACUUM PUMPS

HEATING SPECIALTIES

TEMPERATURE CONTROLS

WE HEAR THAT

Continued

▸ *CONTROLS COMPANY OF AMERICA* has established a production plant in Winamac, Ind.

▸ *UNIVERSAL INSULATING MACHINE CO.* will move its plant in Van Wert, Ohio to new facilities in Winter Haven, Fla. The 6500 sq ft building will house a machine shop, welding shop, assembly, testing and painting departments, as well as office and engineering space.

▸ *CHEMPUMP DIV. OF THE FOSTORIA CORP.* has recently moved into new facilities located at Buck and County line Rds., Huntingdon Valley, Pa.

▸ *KAISER ENGINEERS* have established district offices at 228 N. LaSalle St., Chicago.

▸ *AMERICAN MACHINE AND METALS, INC.* has purchased the assets of *AUTOMATIC DEVICES CO., INC.* of Western Springs, Ill. No management or personnel changes are contemplated.

▸ *MATHES CO.* has announced expansion plans for its Marble Falls, Texas plant. #

THE NEW DISTRICT HEATING HAND BOOK

THIRD EDITION

An Entirely New Volume — 529 Pages
15 CHAPTERS — 6"x9¼"

GROWTH AND PRESENT STATUS
ECONOMICS OF DISTRICT HEATING
GENERAL DATA
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CONSUMERS' ACCESSORY EQUIPMENT
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RATES
SALES ACTIVITIES
HOT WATER FOR DISTRICT HEATING

Price $7.00

NATIONAL DISTRICT HEATING ASSOCIATION
827 N. EUCLID AVE., PITTSBURGH 6, PA.

MEETINGS & CONVENTIONS

1959

OCT. 5-7—*American Gas Association*, annual convention. Conrad Hilton Hotel, Chicago. Information: American Gas Association, 420 Lexington Ave., New York 17.

OCT. 5-8—*Northeast Region Conference of the National Association of Corrosion Engineers*, annual meeting. Lord Baltimore Hotel, Baltimore, Md. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

OCT. 19-23—*47th Annual National Safety Congress and Exposition*. Chicago. Conrad Hilton, Congress, Sheraton, Morrison, Palmer House, LaSalle Hotels. Information: National Safety Council, 425 N. Michigan Ave., Chicago 11.

OCT. 22-23—*Galvanizers Committee* meeting sponsored by American Zinc Institute. St. Francis Hotel, Canton, O. Information: American Zinc Institute, 60 E. 42nd St., New York 17.

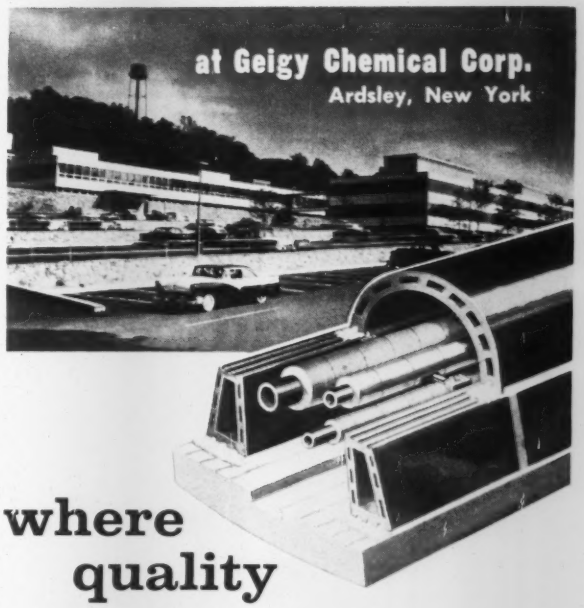
OCT. 27-30—*Insulation Distributor-Contractors National Association, Inc.*, annual convention. Flamingo Hotel, Las Vegas. Information: Insulation Distributor-Contractors Association, Inc., 1632 K St., N. W., Washington 6, D. C.

NOV. 1-6—*Insulation Distributor-Contractors National Association, Inc.*, Mid-Pacific conference. Hawaiian Village Hotel, Honolulu. Information: Insulation Distributor-Contractors Association, Inc., 1632 K St., N. W., Washington 6, D. C.

NOV. 1-6—*American Nuclear Society* winter meeting. Sheraton-Park Hotel, Washington, D. C. Information: American Nuclear Society, 86 E. Randolph St., Chicago 1.

NOV. 12-13—*2nd Annual Texas Conference on the Utilization of Atomic Energy*, A & M College of Texas. Information: A & M College of Texas, College Station, Texas.

NOV. 2-5—*Air-Conditioning and Refrigeration Institute*, 11th exposition. Atlantic City Auditorium, Atlantic City, N. J. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C.



where quality really counts...

Therm-O-Tile IS THE CHOICE

"Quality" isn't just a word, it's a necessity in modern industry. No wonder Guy B. Panero, Consulting Engineer specified Therm-O-Tile conduit for the underground piping here.

QUALITY
Therm-O-Tile is manufactured and installed under a continuing quality inspection system assuring the finest possible product.

ECONOMY
Therm-O-Tile offers double economy: (1) low initial cost (2) low maintenance cost as piping failures within the conduit can be easily located and repaired.

LONG LIFE
A Therm-O-Tile installation will last longer because the vitrified tile with which it is made is one of the most permanent materials known to man.

Get complete details; write today:
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Therm-O-Tile®
CONDUIT FOR UNDERGROUND PIPING

H. W. PORTER CO., INC. NEWARK 12, NEW JERSEY
or Subsidiary
REID HAYDEN, INC.—BALTIMORE • CHARLOTTE • RICHMOND

SIMPLE—4-step water treatment IMPROVES Air Conditioning

End scale, slime and corrosion troubles in air conditioning water with Oakite Airefiner No. 52. All it takes is a ten-minute daily check up by one man. This way you maintain high cooling efficiency and you reduce out-of-service time, too.

How? With a simple four step program. (1) Charge water initially with Oakite Airefiner No. 52. (2) Test water daily. (3) Add upkeep when necessary. (4) Drain system and replace with new, charged water on a periodic basis.

That's all there is to it. Airefiner No. 52 checks slime and algae growth, prevents scale build-up and minimizes corrosion. It leaves tubes clean for efficient heat exchange. It's safe. It's inexpensive.

For explanatory drawings and full details on this time and trouble saving method, ask your local Oakite Technical Service Representative, or write Oakite Products, Inc., 51A Rector Street, New York 6, N. Y.

OAKITE

specialized
WATER TREATING
materials

In our 50th year

Technical Service Representatives in Principal Cities of U. S. and Canada

MEETINGS & CONVENTIONS

Continued

1959

NOV. 16-20—*National Association of Corrosion Engineers*, annual general Florida conference and corrosion short course. Key Biscayne Hotel, Miami. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

NOV. 30-DEC. 11—*Air Pollution Course*. Institute of Industrial Medicine, New York University with the College of Engineering. Information: New York University—Bellevue Medical Center, Institute of Industrial Medicine, 550 First Ave., New York 16.

DEC. 1-4—*National Warm Air Heating and Air Conditioning Association*, committee meetings and annual convention. Chase Hotel, St. Louis, Mo. Information: National Warm Air Heating and Air Conditioning Association, 640 Engineers Bldg., Cleveland 14.

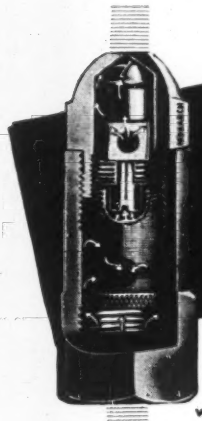
1960

JAN. 25-28—*National Plant Maintenance and Engineering Show*. Convention Hall, Philadelphia, Pa. Information: Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

FEB. 1-4—*2nd Southwest Heating and Air Conditioning Exposition*, Dallas. Under auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, in conjunction with the newly merged society's semi-annual meeting also in Dallas. Meetings to be held in the Baker and Adolphus Hotels; exposition to be held in Memorial Auditorium. Information: International Exposition Co., 480 Lexington Ave., New York 17. ASHRAE headquarters: 62 Worth St., New York 13.

FEB. 1-5—*Instrument Society of America*, instrument-automation conference and exhibit. Houston Coliseum. Information: William H. Kushnick, Executive Director, Instrument Society of America, 313 6th Ave., Pittsburgh 22.

FEB. 2-4—*Society of the Plastics Industry, Inc.* 15th SPI Reinforced Plastics Div. Conference. Edgewater Beach Hotel, Chicago. Information: Society of the Plastics Industry, Inc., 250 Park Ave., New York 17.



Monarch NOZZLES For HUMIDIFYING

Monarch Brass F-80 Air Conditioning Nozzles (or ¼" male one-piece H-261 style) produce the finest possible breakup of small capacities with low direct pressure only. No air required.

The most popular size is #3.00 which operates on as little as 25 pounds pressure, delivers 1.00 gph and produces a very wide angle of spray (120°) in a fine, soft, fog-like mist.

Available in 25 different capacity sizes from .57 gph upwards, all Brass construction with 120 mesh Monel screen strainers.

WRITE FOR CATALOG I

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2523 E. ONTARIO ST.
PHILADELPHIA 34, PA.
Canadian Agents: (Except B. C.)
E. S. Gallagher Sales Ltd., Toronto 12, Canada

ELECTRIC HOT WATER HEAT TO 2,000,000 B.T.U.

- 40,948 B.T.U. to 2,000,000 B.T.U. Output.
- All units meet the requirements of the ASME Boiler and Pressure Vessel Code.

PRECISION Electric HOT WATER HEATING BOILER

- **Complete unit ready for installation** with circulating hot water system and water chiller for year-round air-conditioning.
- **Conversion easily accomplished** where other type fuels now used. Suited for homes, churches, apartments, hotels, motels, hospitals, commercial buildings, swimming pools, snow melting and domestic hot water. Temperature Range 60 to 250 degrees.
- **Every unit tested and inspected.**

Write for color brochure and prices.

PRECISION parts corporation
400-HPAC North 1st Street
Nashville 7, Tennessee

No ducts! No noise! No chimney! No odors! No flame!

YOU CAN BUY AIR FILTERS WITH CONFIDENCE FROM MEMBERS OF...

The Air Filter Institute

AFI MEMBER AIR FILTER INSTITUTE

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New York 16, New York

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Milwaukee 18, Wisconsin

Air-Maze Corporation
25000 Miles Road
Cleveland 28, Ohio

American Air Filter Co., Inc.
215 Central Avenue
Louisville 9, Kentucky

Continental Air Filters, Inc.
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Dollinger Corporation
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Fram Corporation
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Minneapolis-Honeywell Regulator Co.
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Owens-Corning Fiberglas Corporation
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Pittsburgh Plate Glass Company
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One Gateway Center
Pittsburgh 22, Pennsylvania

Research Products Corporation
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*Technical Filter Co.
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McKees Rocks, Pennsylvania

Vortox Company
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Claremont, California

Westinghouse Electric Corporation
Sturtevant Division
Hyde Park, Boston 36, Massachusetts

*Formerly Wilson & Co., Inc.

DEPENDABLE 100% AUTOMATIC REMOTE READING Tank Contents Gauges

- RELIABLE
- NO POWER REQUIRED
- UNDERWRITERS' APPROVED

Liquidometers use a temperature compensated balanced hydraulic system. Indications unaffected by changes in specific gravity. All models feature large easy-to-read dials. UL approved switches available.

Write for complete details to Dept. A

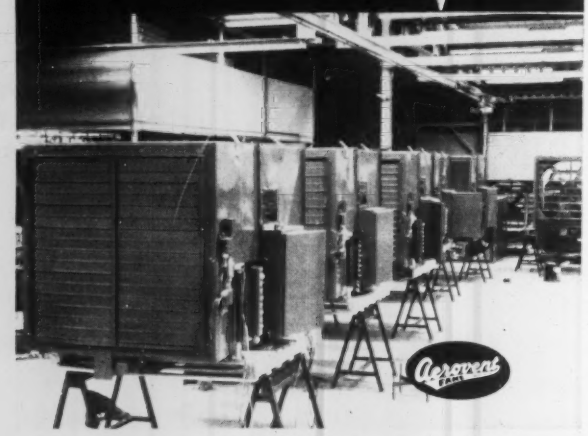
Since 1920 ...of proven quality

THE LIQUIDOMETER CORP.
LONG ISLAND CITY 1, NEW YORK

increase production capacity . . .
improve fan and heating efficiency

with

gas-fired
air
make-up
units



Pictured above is a portion of the final assembly line at Aerovent showing 8 units slated for delivery to a large Midwestern automobile accessory manufacturing plant. Designed to supply ample quantities of clean, pre-heated or cool, outside air to replace air exhausted by ventilating systems, the Aerovent Gas-Fired Air Make-Up Unit keeps air fresh; eliminates drafts and negative pressures. Safe, dependable operation and automatic, semi-automatic or manual control with natural, mixed, manufactured or propane gas.

For winter or summer use, these compact, packaged units are available in four unit arrangements and four sizes from 36" to 54" for various capacities, BTU ratings and pressure conditions.

Write for bulletin 880.

OTHER UNITS AVAILABLE FOR STEAM OR HOT WATER

Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

CERTIFIED PERFORMANCE

Aerovent
FAN COMPANY, INC.
Ash and Branch Streets — Piqua, Ohio

MEETINGS & CONVENTIONS *Continued*

1960

MARCH 14-18—*National Association of Corrosion Engineers*, annual conference and corrosion show. Dallas Memorial Auditorium. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

APRIL 4-7—*Oil Heat Institute of America*; convention and exposition. Convention: Park-Sheraton Hotel, New York, exposition: Coliseum, New York. Information: Oil Institute of America, Inc., 500 5th Ave., New York 36.

APRIL 25-29—*American Welding Society*, annual meeting and exposition. Los Angeles. Information: American Welding Society, 33 W. 39th St., New York.

APRIL 27-30—*Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference*. Shrine Exposition Hall, Los Angeles. Information: Western Air Conditioning Industries Association, 3443 S. Hill St., Los Angeles 7.

JUNE 6-9—*National District Heating Association* annual meeting. Grove Park Inn, Asheville, N. C. Information: National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.

JUNE 10-26—*British Exhibition of Industry, Technology, Science and Culture*. Under sponsorship of the Federation of British Industries and the British Government. New York Coliseum. Information: A. A. Schechter Associates, 551 Fifth Ave., New York 17.

JULY 25-29—*13th International Congress on Occupational Health*. Waldorf-Astoria Hotel, New York. Information: Dr. Leo Wade, 15 W. 51st St., New York. ≠

Obituary

Frederic B. Stubinger

FREDRIC B. STUBINGER, 58, advertising manager of Buffalo Forge Co., died recently in Kenmore Mercy Hospital following a heart attack.

Mr. Stubinger had been instrumental in guiding the advertising program of Buffalo Forge and its subsidiary, Buffalo Pumps, Inc., for 38 years. He came to the concern in March 1921 as assistant advertising manager and was promoted to advertising manager two years later.

■ Now available with extra-heavy "hex" gripping surface (on most sizes) for fast, easy field use, low-cost Mayco Dielectric Bushings stop damaging electrolysis action before it starts. Made from toughest PLASKON nylon... bright red in color... withstand pressures to 1000 lbs., temperatures to 300° F. Control electrolysis on plumbing, heating and gas applications – wherever dissimilar metals are joined.

Order Mayco Dielectric Bushings from your jobber today... or write:

MAY PRODUCTS, INC. Galesburg, Illinois

Manufacturers of MAYCO Dielectric Fittings – MAYCO Water Softeners

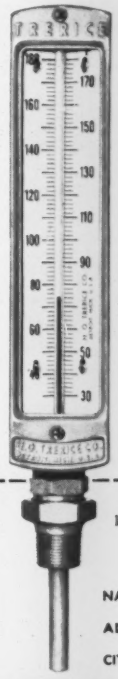
NEW! The high quality of

STAINLESS STEEL

. . . at lower cost!

TRERICE BX SERIES *INDUSTRIAL*

THERMOMETERS



Now available! The new high-quality, low-cost Trerice BX Series Thermometer with stainless steel front and bulb chamber. Easy-to-read scale markings . . . large red appearing mercury tube . . . durable 9-inch cast aluminum case. Guaranteed accurate temperature indication! Available in standard range models from —40°F to 950°F. No extra cost for straight, right side, left side, regular angle, regular oblique, or reverse oblique forms.

H. O. TRERICE CO.
1420-C W. Lafayette Blvd., Detroit 16, Mich.
Please send bulletin 201 describing Trerice BX Industrial Thermometers!

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

TRERICE TEMPERATURE AND PRESSURE INSTRUMENTS

expecting a check?

You'll get it quicker if you gave your postal delivery zone number with your address.

The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include your zone number in your return address - after the city, before the state.

KEY-TITE® Goes on Fast – Seals Tight

Cut assembly time with Key-Tite, the tight sealing waterproof pipe joint compound. It's ideal for water, gas, and low pressure lines—safe for potable liquids—contains no toxic ingredients. Actually lubricates and protects threads while it seals—joints don't freeze.

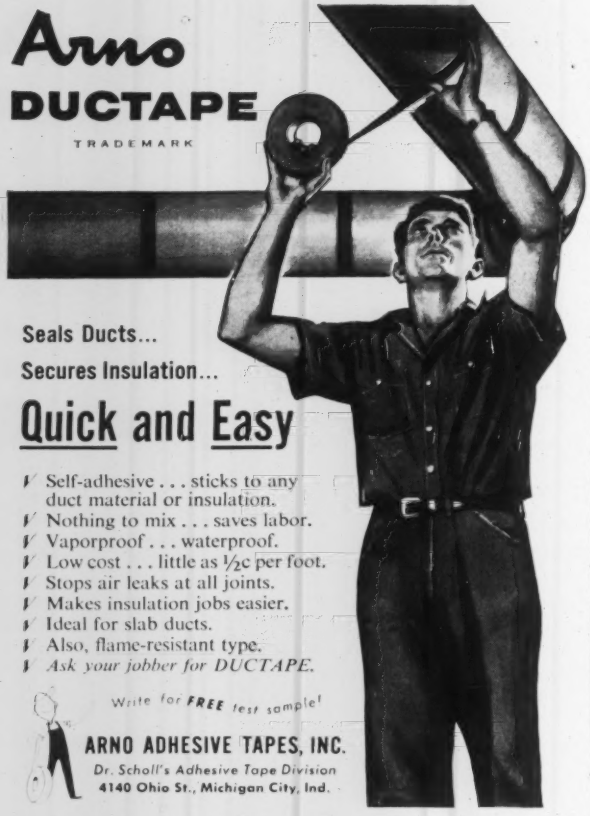
Key-Tite is easy to apply with a brush – no crumbling or waste. Extra long open-can life eliminates thinning and stirring.

Available in pints, quarts, 1 gallon and 5 gallon cans, and 500 lb. drums. Write for Circular 239-B and free sample.

W-K-M DIVISION OF ACF INDUSTRIES INCORPORATED
Dept. BB-10, P. O. Box 2117, Houston, Texas

KT 5805

Arno DUCTAPE
TRADEMARK



Seals Ducts...
Secures Insulation...

Quick and Easy

- Self-adhesive . . . sticks to any duct material or insulation.
- Nothing to mix . . . saves labor.
- Vaporproof . . . waterproof.
- Low cost . . . little as ½c per foot.
- Stops air leaks at all joints.
- Makes insulation jobs easier.
- Ideal for slab ducts.
- Also, flame-resistant type.
- *Ask your jobber for DUCTAPE.*

Write for **FREE** test sample!

ARNO ADHESIVE TAPES, INC.
Dr. Scholl's Adhesive Tape Division
4140 Ohio St., Michigan City, Ind.

NOW! *Jetglas*-C PROTECTION

on the
DAY & NIGHT GAS-FIRED UNIT HEATER

Missile nose-cone durability has given birth to important by-products like **Jetglas-C**, the miracle protection for heat exchangers on Day & Night unit heaters. Can't burn out, can't rust out, can't wear out! Add that to design advantages that provide for easy installation, easy cleaning and maintenance, super-quiet efficient operation—and you have the finest unit heater on the market today. For complete information, write to:

DAY & NIGHT MANUFACTURING CO.
855 Anaheim-Puente Rd. • La Puente, Calif.

NEW BOOKS & REPORTS...

New Lessons in Arc Welding. 108 pp. The Lincoln Electric Co., Cleveland 17, O.

Aluminum Construction Manual. 389 pp. The Aluminum Association, 420 Lexington Ave., New York 17.

Factors in Special Fire Risk Analysis. by William Durant Milne. 165 pp. Chilton Co.—Book Division, 56th and Chestnut Sts., Philadelphia 39, Pa. $10.00

Protective Maintenance of Motors and Generators. 63 pp. Renewal Parts Section, National Electrical Manufacturers Association, 155 E. 44th St., New York 17.

Underground Heat Distribution Systems. by Building Research Advisory Board, National Academy of Sciences, 2101 Constitution Ave., Washington 25, D. C. $1.50

Corrosion Prevention. by U. S. Navy Bureau of Yards and Docks. 431 pp. Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. $6.00

Basic Mechanical Engineering. Chief of Civil Engineers, Bureau of Yards and Docks. 106 pp. U. S. Department of Commerce, Washington 25, D. C. $2.50

IC 1-1959 *Industrial Control*. National Electrical Manufacturers Association, 155 E. 44th St., New York 17. $6.00

Equipment Maintenance with Various Numbers of Service Men: A Simple Analysis. Wright Development Center. 41 pp. U. S. Department of Commerce, Washington 25, D. C. $1.25

Analysis of Pipe Structures for Flexibility. by John Gascoyne. 131 pp. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. $7.50

Recommended Commercial Standard for Copper Drainage Tube (DWV), TS-5157. Commodity Standards Div., U.S. Dept. of Commerce, Washington 25, D.C.

Commercial Standards for Mechanical Equipment, Instruments and Tools, Ventilating and Refrigeration, Plastics, Pipe and Fittings, Thermal Insulation Materials. Commodity Standards Div., U.S. Dept. of Commerce, Washington 25, D.C. ≠

"Who Makes It?"
"Where Can We Get It?"

FOR THEIR ANSWERS

CONSULTING ENGINEERS
ENGINEERS IN INDUSTRIAL PLANTS
ENGINEERS IN LARGE BUILDINGS
&
MECHANICAL CONTRACTORS

GO TO THE *BIG* ANNUAL

Heating, Piping & Air Conditioning January Directory Number

Start Making *Your* Plans *Now* For Adequate Space In The January 1960 Issue

For leakproof, pressure-tight connections..

TiteSeal®
Gasket & Joint
SEALING COMPOUNDS

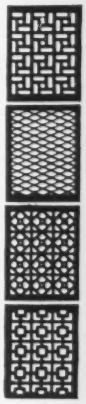
Heat-proof, vibration-proof. Will not shrink, crack or crumble. Prevents formation of rust and corrosion—makes disassembly easy.

Solder Seal

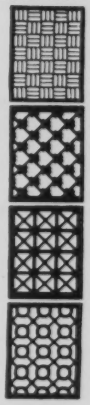
At your wholesaler!

2194

RADIATOR SPECIALTY CO., Charlotte, N. C.



DIAMOND TRADE MARK GRILLES



Look Better — Last Longer

Superior workmanship and finish in heavy-gauge metal assures installations of lasting beauty. Most designs stamped in any thickness, up to one-fourth inch, from any metal. Catalog No. 36 illustrates all designs and gives complete working data. Free on request.

Diamond Manufacturing Co.
Box 34 Wyoming, Pa.

Manufacturers, also, of DIAMONTEX, the Perforated Metal Lay-In Panel for Modern Acoustical Ceilings.

. . . find what you need quickly and economically through . . .

CLASSIFIED ADVERTISING

Rates for classified advertising are 15 cents for each word including heading and address. One inch $7.00. Count nine words for keyed address. Minimum $2.50 for each insertion. Cash must accompany order. Closing date 10th of month preceding issue.

✔ SITUATIONS OPEN

SALES ENGINEER

Opportunity for growth with New England manufacturer of centrifugal pumps, heat exchangers and allied equipment for heating and cooling applications. Essential to have a record of sales experience and accomplishment in selling specification equipment to wholesalers, contractors, engineers and architects preferably in the heating and cooling field. Mechanical engineering or other technical degree or equivalent experience required. Must be willing to relocate and travel. Send resume, salary history and requirements. All replies will be kept confidential. Address Key 1421A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

MECHANICAL ENGINEERS

With 3 or more years experience in mechanical design for buildings including heating, air conditioning, plumbing, etc. Permanent employment with well-established midwestern consulting engineering firm. Write Key 1423A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill., giving personal resume and required salary.

✔ AGENTS WANTED

MANUFACTURER'S AGENTS

An established manufacturer with 25 years experience, producing ventilating equipment is looking for manufacturer's agents in many sections of the country to sell their new line of industrial fans.

The products include axial flow and tubeaxial fans, both direct and belt driven, and power roof ventilators. Please reply Key 1361A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

INDUSTRIAL VENTILATOR SALES

Large Eastern Manufacturer is looking for additional agents to sell established line of gravity and power industrial roof ventilators. Knowledge of industrial ventilation is necessary. Agents must now be calling on engineers, purchasing agents, contractors and architects. Give full details in letter to Key 1431A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

✔ MISCELLANEOUS

IDENTIFICATION NAME PLATES for controls and panels — precision engraved on bakelite or black anodized aluminum — any titles — quick service by mail on small or large jobs — send for sample and prices. ATLANTIC ENGRAVERS, Coldbrook Road, Wilmington, Vermont.

✔ SITUATION WANTED

Registered Mechanical Engineer available. Eight years experience in estimating, design and installation of mechanical facilities in industrial plants, office and laboratory buildings. Resume on request. Address Key 1430A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

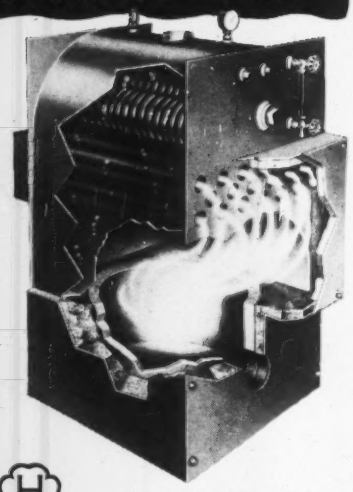
✔ LINES WANTED

CHICAGO AREA MANUFACTURERS REPRESENTATIVE

8 years spent calling on architects, engineers and mechanical contractors. Looking for manufacturer of heating and ventilation equipment that needs engineering and aggressive selling. Address Key 1432A, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

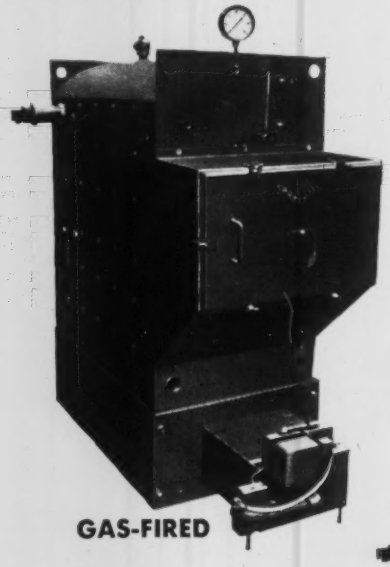
Portmar TWIN COIL VOLUME WATER HEATER ELIMINATES THE STORAGE TANK!

Instantaneously supplies large quantities of automatic hot water for coin operated laundries • commercial laundries • dry cleaners • apartment houses • motels restaurants • hotels • hospitals • schools factories • processing plants



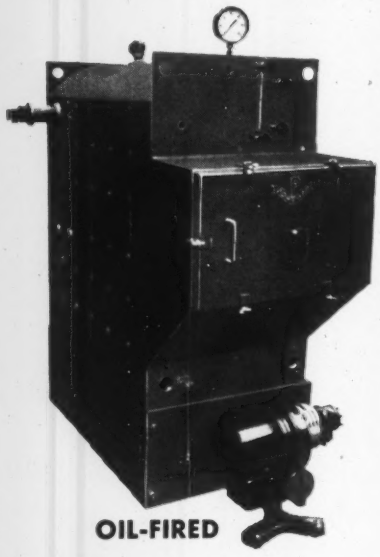
Cross section showing position of submerged twin copper coils.

A.S.M.E.



GAS-FIRED

WH SERIES — 14 Sizes
350,000 to 6,225,000 BTU per hour
Hot Water Delivery: 300 to 6,000 GPH



OIL-FIRED

- Instant supply of sanitary hot water from twin tankless copper coils
- No cumbersome storage tank required
- Rust-free water at all times
- Rapid recovery rate
- Heavy gauge steel built to ASME Construction Code
- Compact water heater can be placed in limited floor space
- Peak efficiency and plenty of built-in reserve to meet excessive demands
- Supplies two temperature hot water: 140° for general use; 180° for sterilizer-rinse
- 180° water temperature reached in a matter of minutes after weekend shutdown
- Complete with oil or gas burner

PORTMAR

For complete details, write for Catalog 4-P.

"Engineered Quality Steel Water Heaters"

Portmar Water Heater Company, Inc.

Division of Portmar Boiler Company, Inc.

193 Seventh Street, Brooklyn 15, N. Y. • Phone TRiangle 5-8777

RESIDENTIAL, COMMERCIAL, INDUSTRIAL WATER HEATERS AND HEATING BOILERS
VERTICAL, HORIZONTAL TUBULAR BOILERS • SCOTCH MARINE BOILERS

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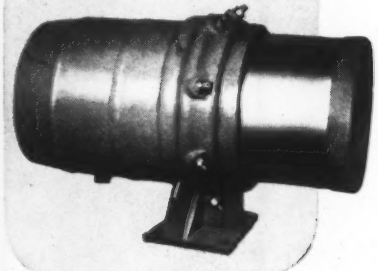

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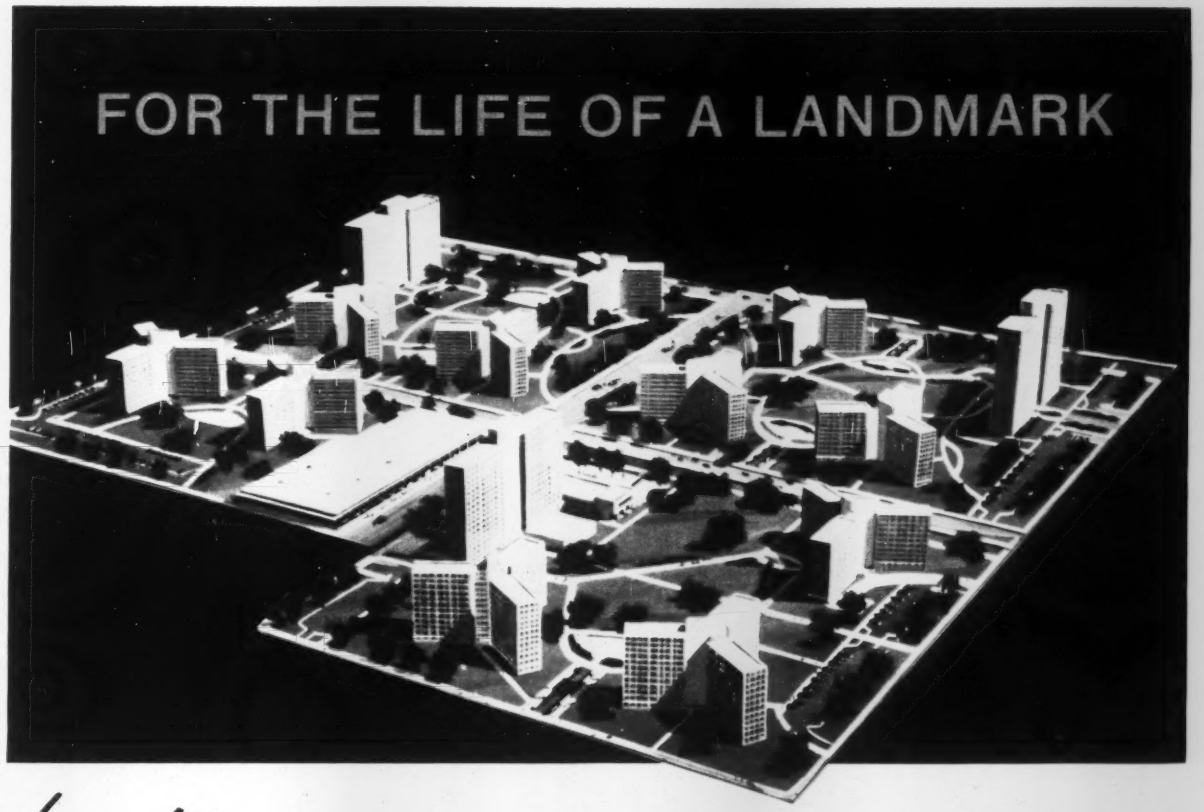

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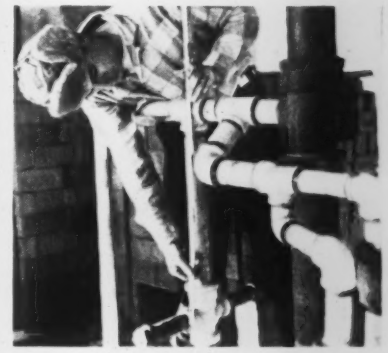

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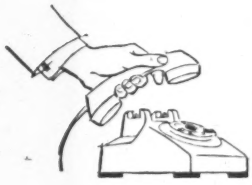

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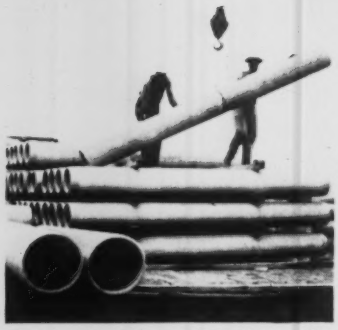

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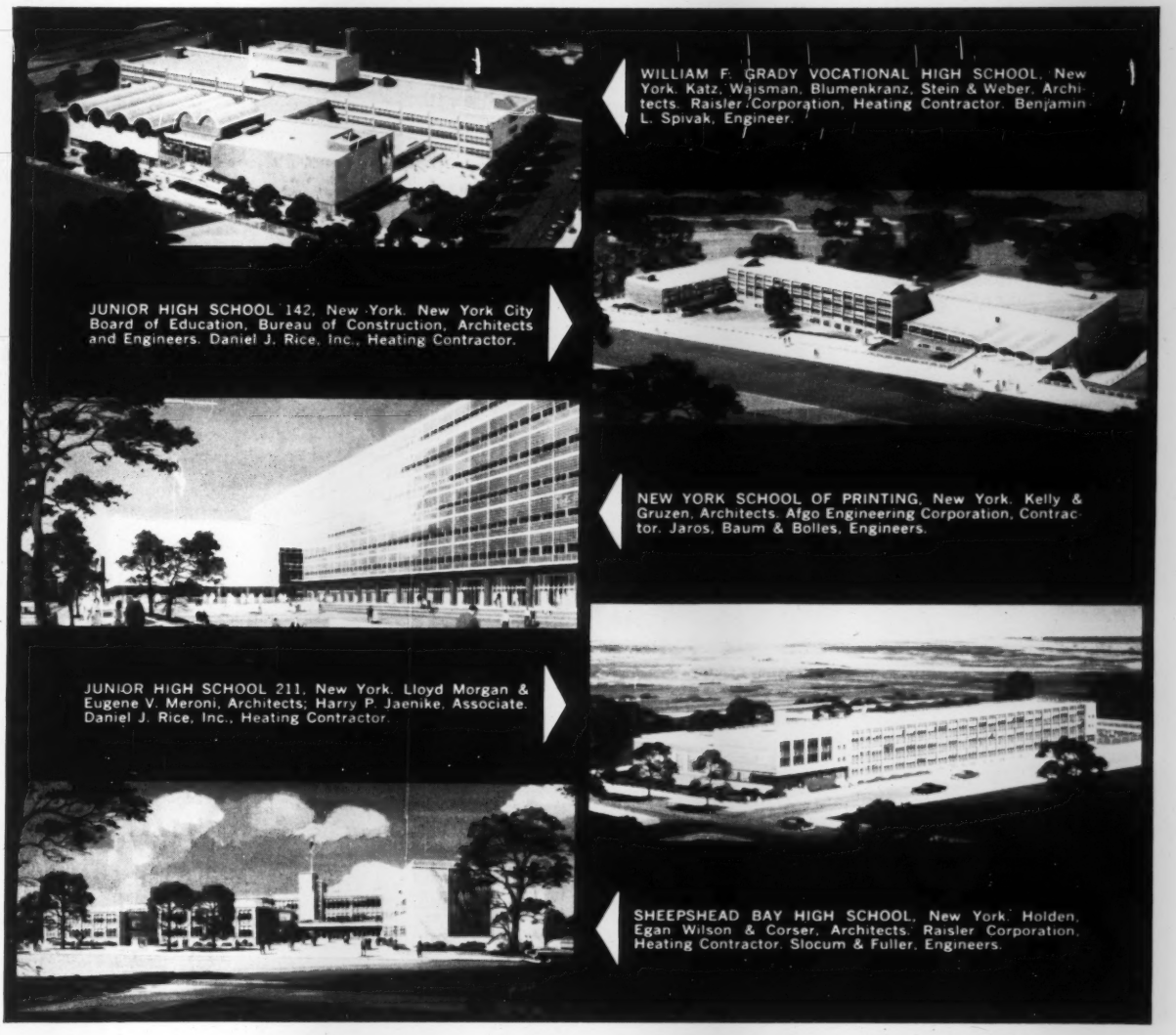

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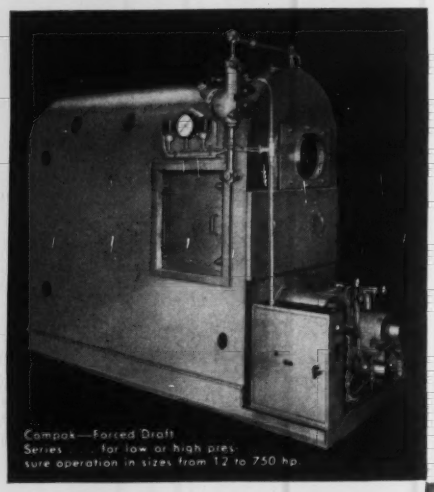

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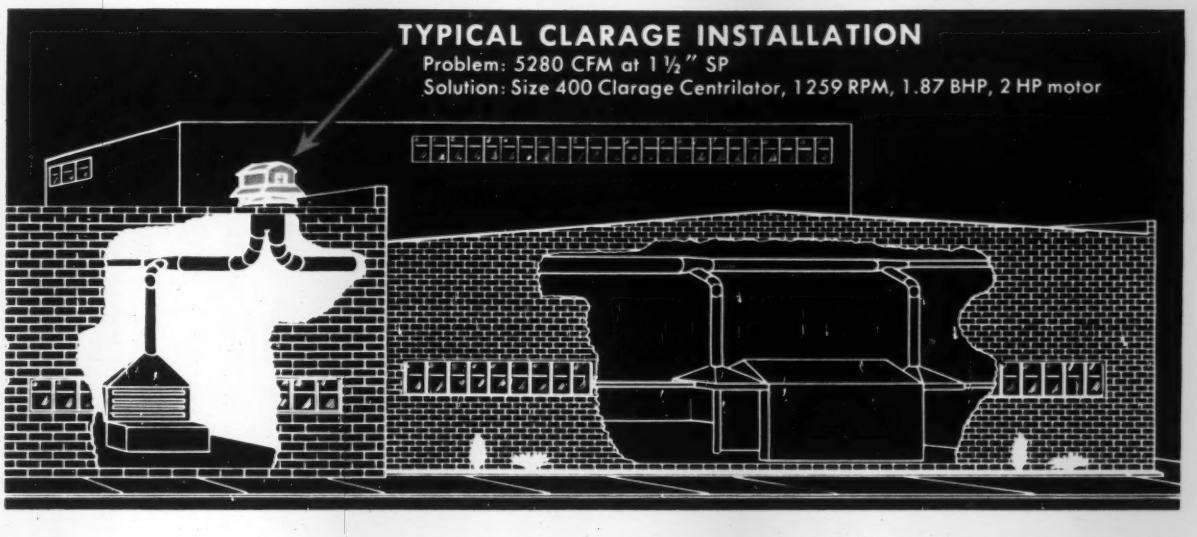
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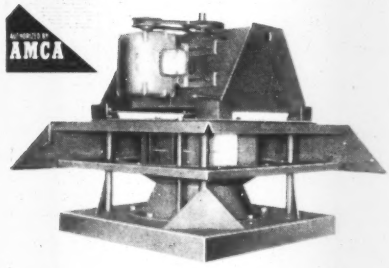

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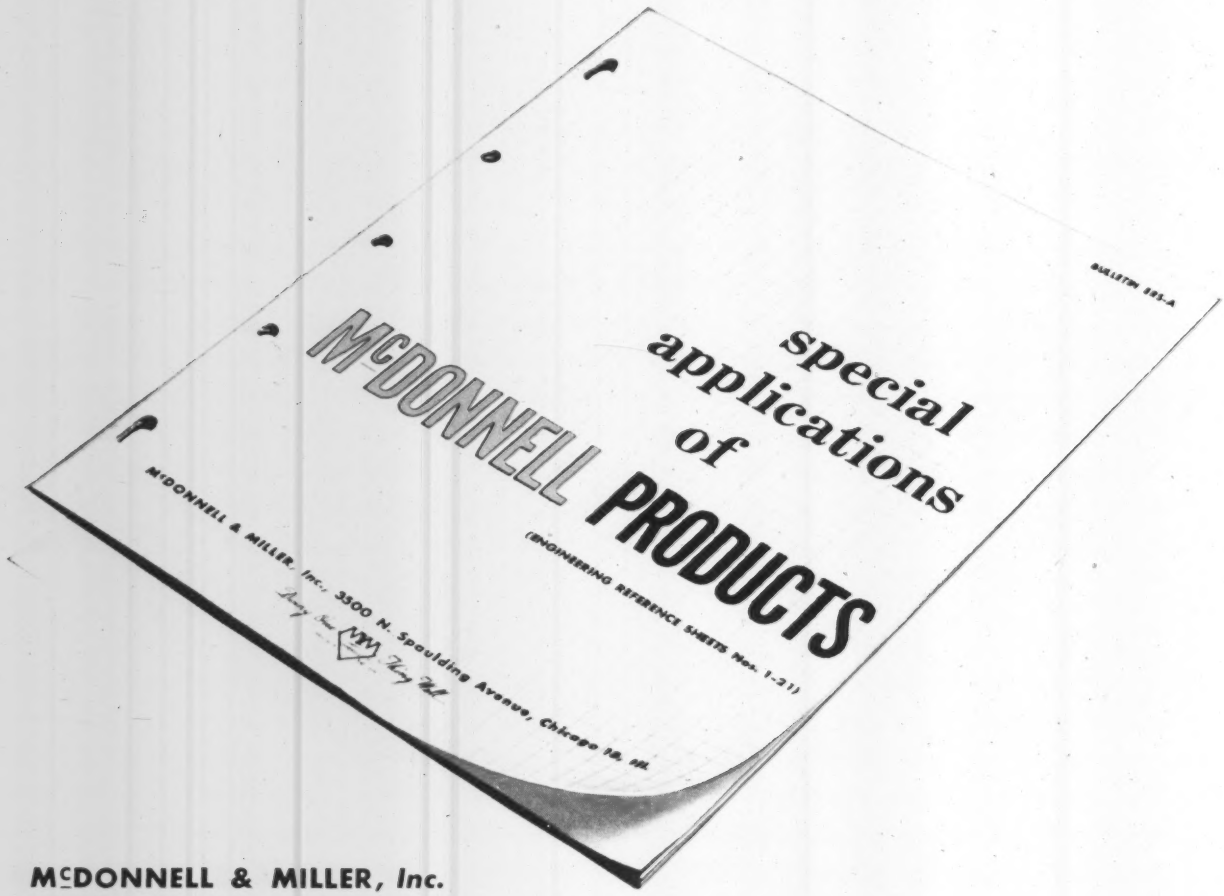
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